UNIVERSITY OF WASHINGTON
DEPARTMENT OF

METEOROLOGY AND CLIMATOLOGY

Scientific Report

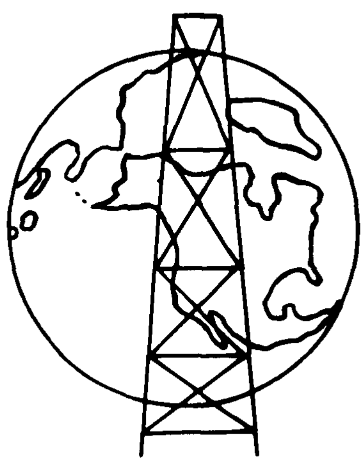
Office of Naval Research Contract 477(24) (NR 307-252)

STATION ARLIS-I OCEANOGRAPHY

Part I, Results

1960 and 1961

BY G. E. BRAYTON



62-2-6

FEBRUARY 1962

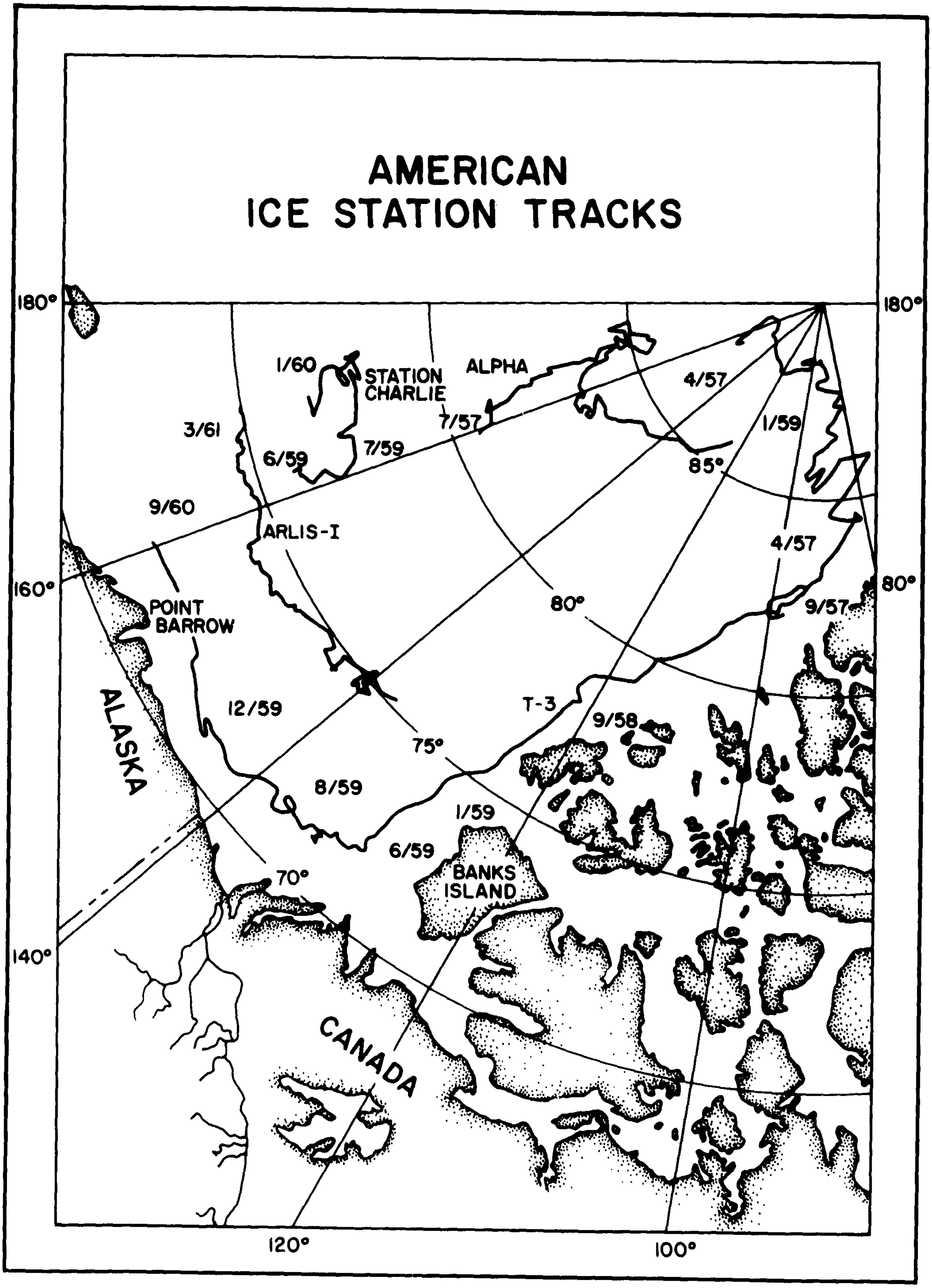
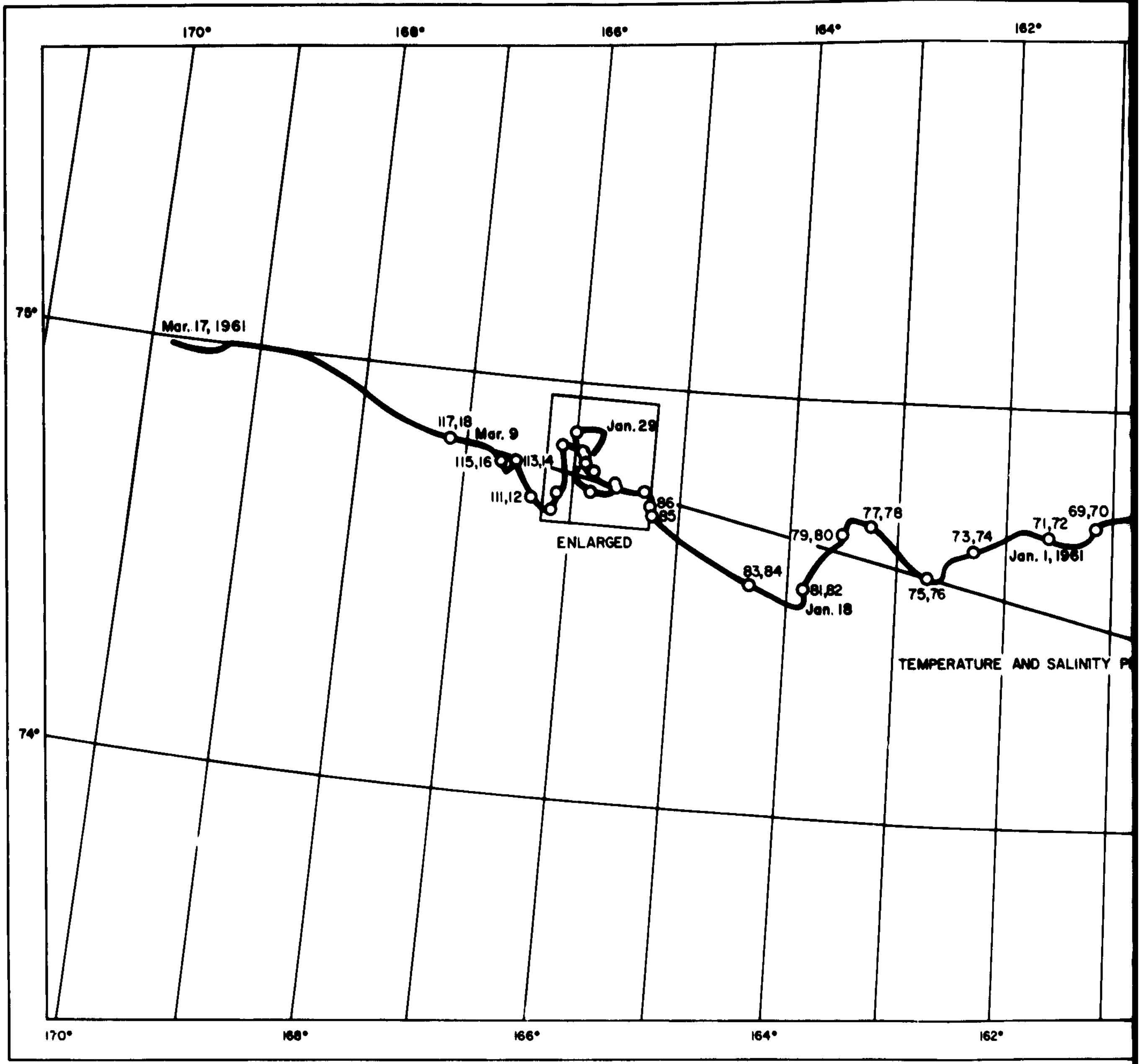
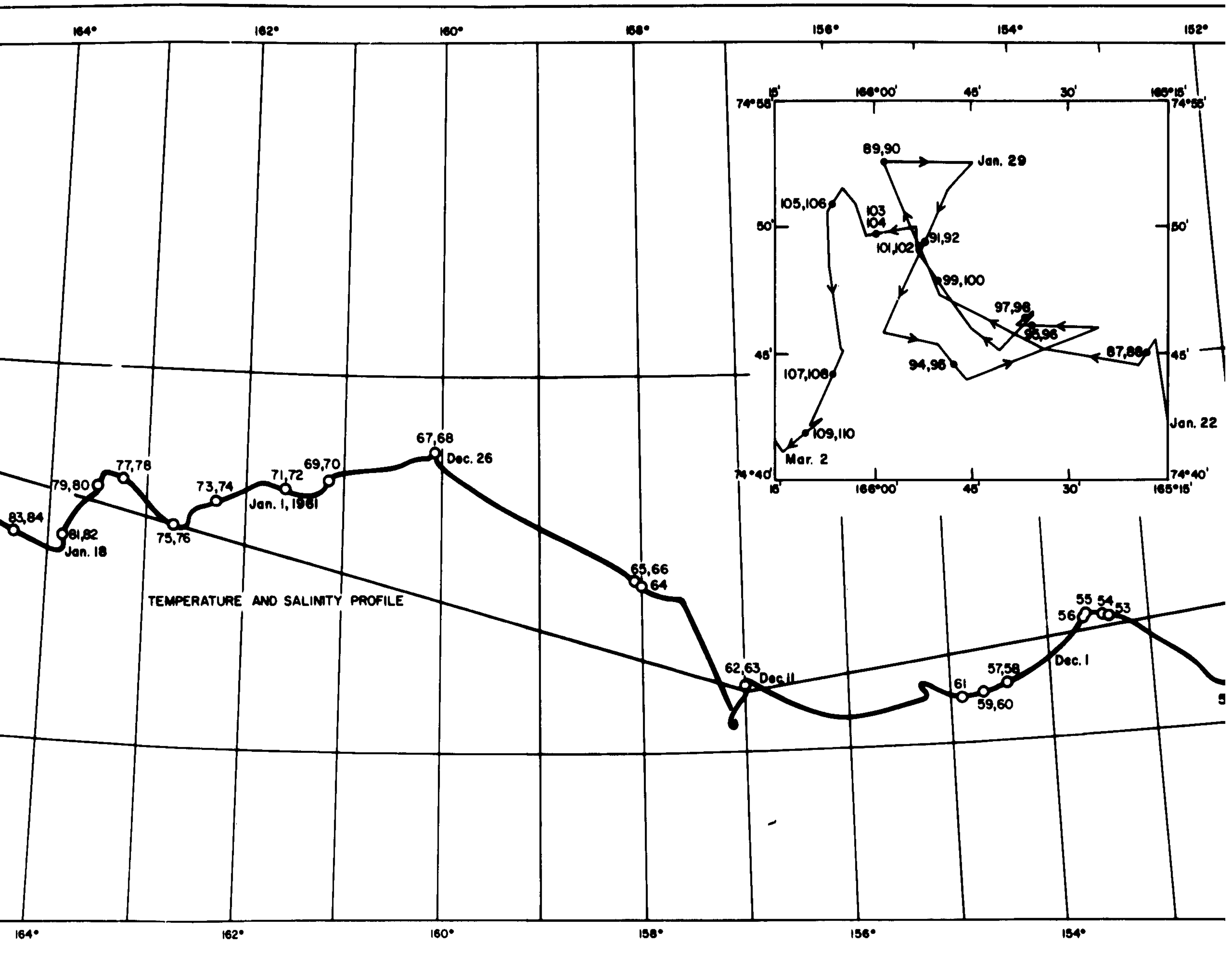

AMERICAN
ICE STATION TRACKS
180°
180°
1/60
STATION
CHARLIE
ALPHA
4/57
3/61
7/57
1/59
6/59
7/59
85°
9/60
ARLIS-I
4/57
160°
80°
POINT
BARROW
80°
9/57
T-3
ALASKA
12/59
9/58
75°
8/59
1/59
6/59
BANKS
ISLAND
70°
140°
CANADA
120°
100°

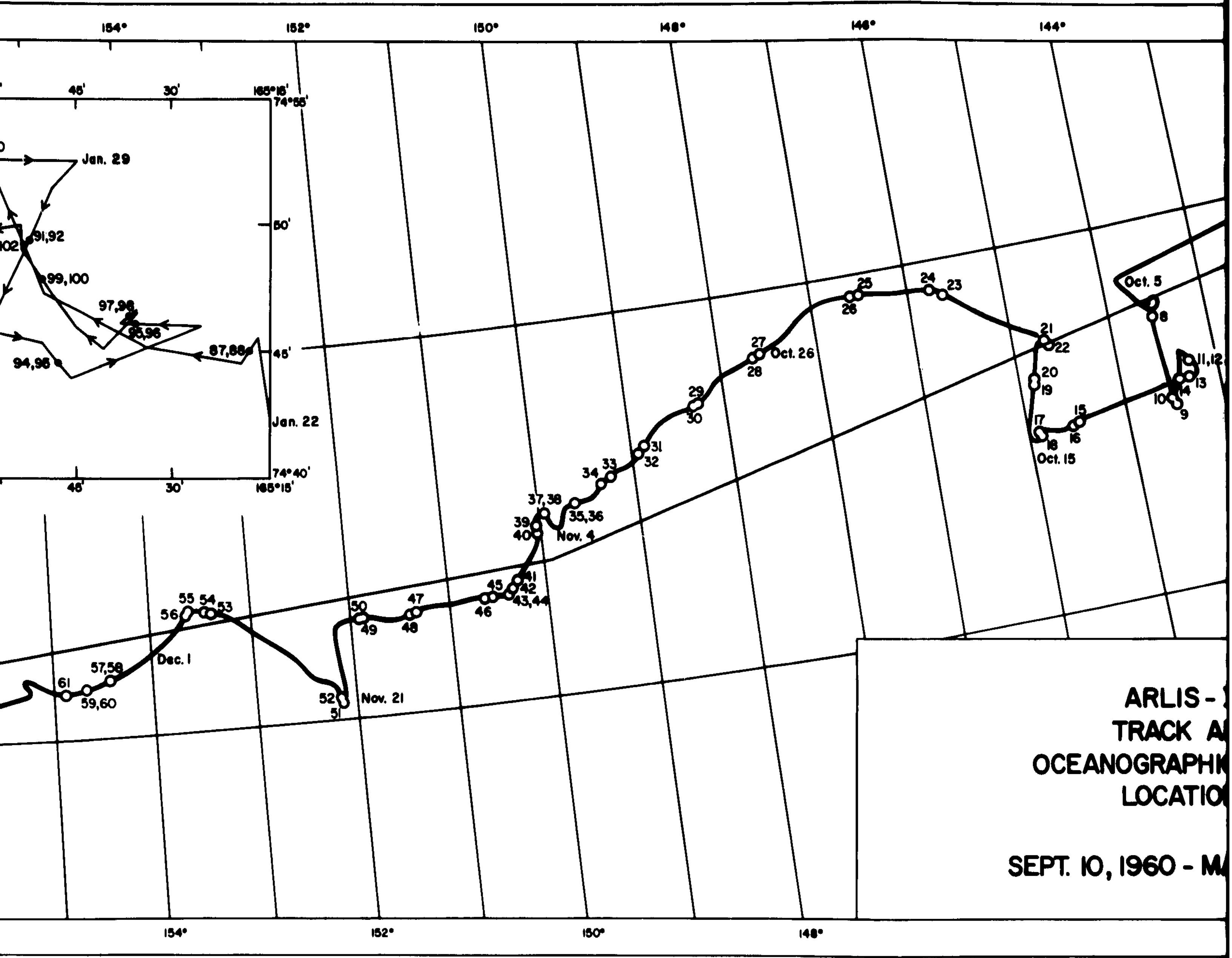
Fig. 1


170°
168°
166°
164°
162°
75°
74°
Mar. 17, 1961
117,18
Mar. 9
115,16
113,14
111,12
Jan. 29
86
85
ENLARGED
83,84
81,82
Jan. 18
79,80
77,78
75,76
73,74
71,72
69,70
Jan. 1, 1961
TEMPERATURE AND SALINITY P

1


164°
162°
160°
158°
156°
154°
152°
74°55'
74°40'
166°00'
45'
30'
165°15'
50'
89,90
Jan. 29
105,106
103
104
91,92
101,102
99,100
97,98
95,96
87,88
94,96
107,108
109,110
Mar. 2
Jan. 22
67,68
Dec. 26
77,78
79,80
83,84
81,82
Jan. 18
75,76
73,74
71,72
Jan. 1, 1981
69,70
65,66
64
TEMPERATURE AND SALINITY PROFILE
62,63
Dec. 11
61
59,60
57,58
56
55
54
53
Dec. 1

2



154°
152°
150°
148°
146°
144°
45'
30'
165°15'
74°55'
50'
45'
74°40'
Jan. 29
Jan. 22
91,92
102
99,100
97,98
95,96
94,95
87,88
Oct. 5
Oct. 15
Oct. 26
Nov. 4
Nov. 21
Dec. 1
ARLIS-
TRACK A
OCEANOGRAPHI
LOCATIO
SEPT. 10, 1960 - M

3

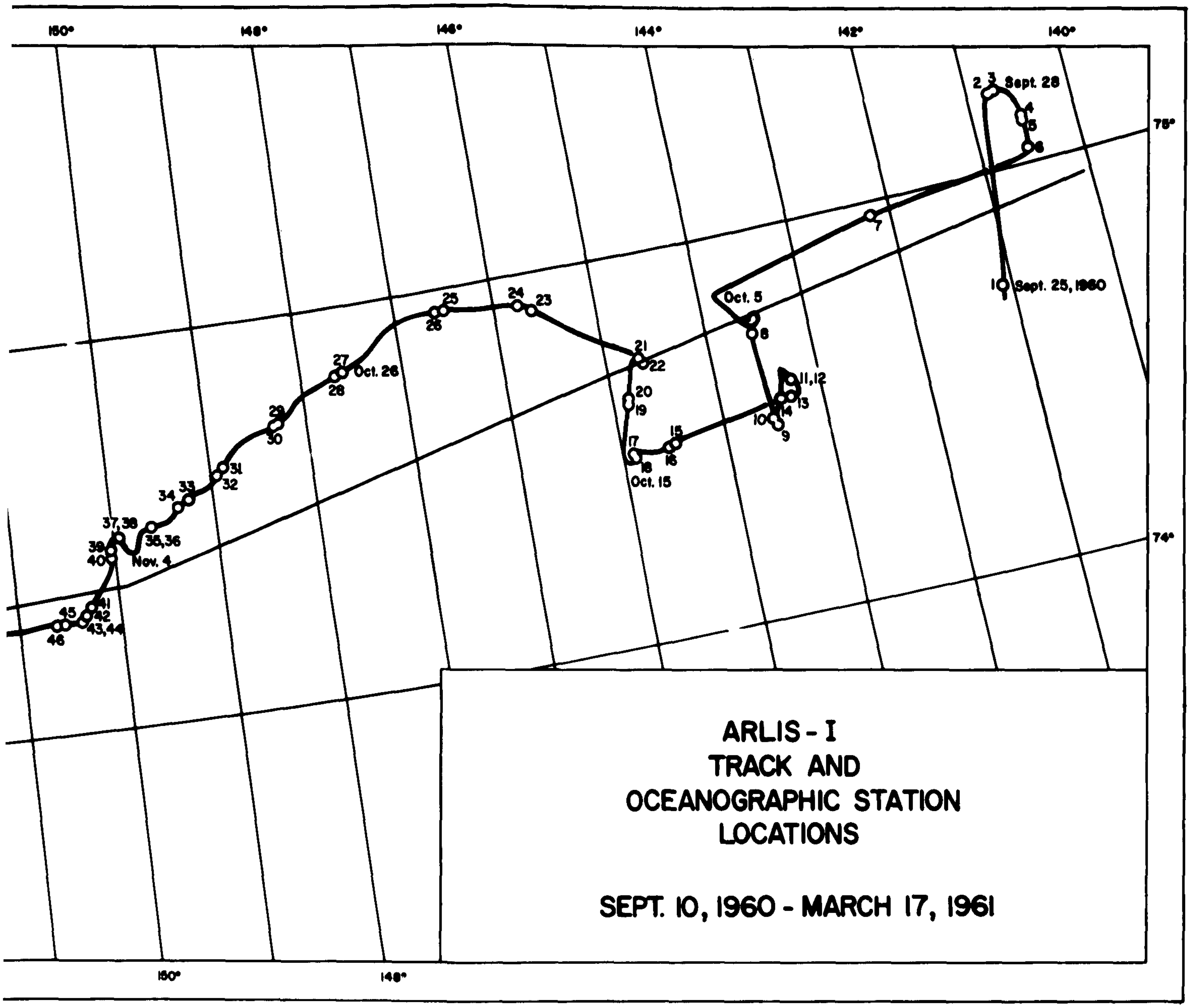

150°
148°
146°
144°
142°
140°
75°
74°
2
3
Sept. 28
4
5
6
7
1
Sept. 25, 1960
Oct. 5
8
11,12
13
14
10
9
15
16
17
18
Oct. 15
19
20
21
22
23
24
25
26
27
Oct. 26
28
29
30
31
32
33
34
35,36
37,38
39
40
Nov. 4
41
42
43,44
45
46
ARLIS - I
TRACK AND
OCEANOGRAPHIC STATION
LOCATIONS
SEPT. 10, 1960 - MARCH 17, 1961

Fig. 2

4

PART I - TABLE OF CONTENTS

List of Figures

Appendix

P R E F A C E

This report contains an analysis of the physical and chemical oceanographic data collected during the winter of 1960-1961 in the Arctic Ocean from the Arctic Research Laboratory's Ice Station (ARLIS I). Included in this report is a combined navigational and station location chart together with graphs of temperature, salinity, and sigma-t. All of the bathythermograph slides have been reproduced and are also included.

The investigations were carried out under the general supervision of Dr. Phil Church (Executive Officer, Department of Meteorology and Climatology) and Dr. Clifford Barnes (Department of Oceanography), both of the University of Washington. George E. Brayton, Oceanographer, directed the planning of the investigations, the field work on the ice, the laboratory analysis of samples and the presentation of the data. Dr. Kenneth Bennington assisted a great deal with the field work and Mrs. Perla Brayton titrated all of the chlorinities.

Mr. Max Brewer, Director of the Arctic Research Laboratory, Point Barrow, Alaska, had the primary responsibility for the establishment of a suitable winter camp on the polar ice pack and for periodic resupply of equipment by airdrop and occasional landings on the ice floe by light aircraft.

INTRODUCTION

The floating ice station ARLIS I (Arctic Research Laboratory's Ice Station No. 1) was occupied by scientific personnel from September 10, 1960, until March 17, 1961, during which time it traveled westward between the 74th and 75th parallels of latitude more than 500 miles across the Beaufort Sea north of Alaska. This is the final report on the oceanographic work and contains all physical and chemical data collected during its occupation.

A comprehensive oceanographic sampling program was carried out which included 118 stations to a maximum depth of 1200 meters, and 139 casts with a bathythermograph capable of recording temperatures to a depth of 900 feet.

Temperatures have been corrected for all reversing thermometers, thermometric depths computed, salinities titrated, and sigma-t values have been computed for all of the oceanographic stations. The geopotential anomalies in dynamic meters have been computed for all of the deep stations (1200 meters, or to the bottom when depths were less than 1200 meters) along the course of the drift.

Observed data for all stations together with interpolated and computed data for deep stations have been tabulated and are presented in this report in the Data Tables (see Part II).

A vertical graph of temperature and salinity and a diagram of temperature plotted against salinity, with curves of sigma-t have been

presented for each oceanographic station. Vertical profiles of temperature and salinity from 4 meters to 1200 meters depth along the track of ARLIS I, enlarged temperature and salinity profiles of a layer of water between 40 meters and 150 meters and each bathythermograph slide have also been drawn and included in this report.

The purpose of the oceanographic investigations in the Arctic Ocean was to accumulate as much physical and chemical data as possible during the winter months to supplement existing knowledge, and specifically to sample in detail a warm layer of water believed to exist between 40 and 150 meters depth.

This work was supported by the Office of Naval Research under Contract Nonr 477(24), Task Order 307-252, through the Department of Meteorology and Climatology of the University of Washington.

PREPARATION AND ESTABLISHMENT OF THE ICE STATION

The Arctic Research Laboratory's Ice Station No. 1 (ARLIS I) was the fourth floating ice station established and maintained by the United States Government for scientific research in the Arctic Ocean area. The first three ice stations were established and supported by the U. S. Air Force by the use of aircraft. ARLIS I was a departure in ice station logistics; it was established by the U. S. Navy with the use of the USS Burton Island. All of the buildings, heavy operating equipment and the majority of supplies needed for seven men to live six months were transported by the Burton Island to the ice floe in one trip. Thereafter, it was believed any supplemental equipment or supplies could be delivered to ARLIS I from Point Barrow by the use of the Arctic Research Laboratory's light aircraft (Cessna 180's).

Equipment and supplies were loaded aboard the USS Burton Island at Point Barrow between September 1 and September 3, 1960. The icebreaker then sailed easterly close to the Alaskan and Canadian coasts to avoid heavy ice. Upon reaching an area to the southwest of Banks Island, the Burton Island then sailed northerly to a point off Banks Island at about 75° N. The ship then entered the ice pack and steamed westerly in search of a suitable floe on which to set up a camp.

On September 10, 1960, an adequate ice floe was located at about 75°07' and 135°16', and off-loading began. All of the scientists and crew members that could be spared took part in unloading the ship and building the camp. Most of the camp construction work was completed on September 12, and the Burton Island prepared to depart for Point Barrow.

Seven men were left on the ice floe to complete construction of the camp and to carry out scientific investigations. They were:

Dr. Kenneth Bennington, University of Washington, ice physicist and station leader;

Dr. Charles Knight, University of Washington, ice physicist and assistant station leader;

Mr. George E. Brayton, University of Washington, oceanographer;

Mr. Arnold Hanson, University of Washington, micrometeorologist;

Mr. Robert Ditzler, University of Washington, micrometeorologist and radio operator;

Mr. John Tibbs, University of Southern California, marine biologist;

Mr. Frank Akpik, Arctic Research Laboratory, camp maintenance.

The oceanographic installation, which consisted of the oceanographic hut, two winches, and a four-foot square hole through the twelve-foot thickness of ice, was not completed until September 25th. The first oceanographic observations were made on September 25, 1960, and were continued at closely spaced time intervals until the station was abandoned on March 17, 1961.

The tracks of the four American ice stations, their areal relationship to each other, and their approximate coverage of the Arctic Ocean north of Alaska and Canada are shown in Figure 1. The course taken by each ice station is an indication of the anticyclonic pattern of circulation believed to exist in this part of the Arctic Ocean.

The track chart of ARLIS I from September 25, 1960, until March 17, 1961, is shown in Figure 2. All oceanographic stations are included, and an occasional navigational position has been indicated. For detailed navigational information, see Table 3 of this report. The line along which the temperature and salinity profiles were constructed has been indicated on Figure 2.

Oceanographic observations were conducted by George E. Brayton between September 25, 1959, and December 7, 1960, at which time he returned to the Arctic Research Laboratory to supervise the reduction of data and salinity titrations. Field sampling was continued by Dr. Kenneth Bennington until March 11, 1961, shortly before the station was abandoned.

METHODS OF FIELD SAMPLING

A special plywood work hut was constructed over a four-foot square hole through the ice, the use of which was shared by the oceanographer and the marine biologist. The hut contained a large and a small winch, tripod, stove, Nansen bottle rack, and a drying area for plankton nets.

The large winch became inoperative at a very early date and could not be used for the remainder of the occupation of the ice station. A small electro-hydraulic winch with 1200 meters of wire which had been taken along in reserve proved adequate for all oceanographic and biological sampling to that depth.

It was believed that a warm layer of water of possible Bering Sea origin might be present in the Beaufort Sea between 40 and 150 meters depth, and detailed sampling throughout this layer was desirable. The warm layer was located by bathythermograph, and the following sampling procedure was adopted and followed whenever possible. A bathythermograph cast was made to a depth of 900 feet. The resulting slide was inspected visually to ascertain the depth of significant temperature fluctuations to determine whether the standard intervals of the Nansen Bottles should be altered to adequately cover any changes in the profile. Next, an oceanographic station would be made with the bottles placed to cover temperature fluctuations (in most cases, standard depths were adequate) from just below the ice at four meters to a depth of 1200 meters. Two casts were made, one from four to two hundred meters and the other from two hundred fifty to twelve hundred meters. The deeper cast was usually made first as storms occasionally arose suddenly, making a deep cast very difficult.

Unprotected thermometers were placed at the 100, 200, 300, 500, 800, and 1200 meter levels. Later, as a further check of depth calculations, two unprotected reversing thermometers were used at some of these levels.

A shallow, more detailed station which sampled the warm water layer at five meter intervals followed each deep station except in a few instances in early October, 1960. The shallow (5 meter interval) stations at first covered depths between 40 and 95 meters until station 28 on October 26, 1960, when the depth range of sampling was increased

to 40-135 meters. When a shallow station was made after a deep station, the data from the two stations was combined in one diagram; therefore, depths such as 50, 75, and 100 meters were not repeated on the shallow station. Often one depth, such as forty meters, was sampled on both stations to help in comparing the data later.

Each pair of deep and shallow stations was always concluded with a bathythermograph cast.

Salinity

Salinity samples were bottled and labelled and stored in a warm place awaiting shipment to Point Barrow for titration.

Resupply aircraft from Point Barrow were expected to arrive at ARLIS I by early November, but because of bad flying conditions were not able to make the trip until November 23, 1960. The supply of chlorinity bottles was exhausted on station 40, November 7, 1960. It was decided to continue measuring temperatures, however, as all types of winter data in this part of the Arctic Ocean are badly needed. Therefore, no chlorinity samples were collected for stations 41-50, for a period of almost two weeks.

During the transport of chlorinity samples to the Arctic Research Laboratory by light plane, some bottles were broken due to freezing, but in spite of the extremely cold weather encountered, loss by freezing was small.

Temperature

Temperatures were recorded and corrected as they were

obtained. At frequent intervals they were compared with the BT trace to spot any erratic behavior in the performance of the reversing thermometers.

Oxygen

Originally it had been planned to titrate oxygen samples on ARLIS I, but the necessary glassware was misplaced during the loading or unloading of the Burton Island and never arrived on the ice station.

Depth Sounding and Bottom Samples

Depth measurements were impossible throughout most of the life of the station because there was no workable echosounder on the ice station and the oceanographic winch carried only 1200 meters of wire, whereas the depth of water throughout most of the trip is believed to have been about 3500 meters. For this reason no bottom sampling was possible.

Towards the middle of January, 1961, ARLIS I drifted into shallower water and it was possible to make some depth measurements with the 1200 meter winch. Depths in this area varied from 747 meters at station 81 to between 400 and 450 meters from station 85 to 118.

Current Measurements

Current measurements were attempted several times, but without much success. A Japanese made Ekman-Merz current meter was used; some of the drawbacks of using this type of instrument under Arctic conditions became immediately apparent. Current directions are determined with the Ekman-Merz current meter by a magnetic

compass. Most of the area traversed by ARLIS I is extremely unreliable magnetically, as far as horizontal directions are concerned, and the directional information obtained is of questionable value.

Because the oceanographic hut could not be heated adequately, the current meter clocking mechanism, shot chambers, etc., would freeze solidly every time the instrument was taken out of the water for a reading. It would then have to be thawed out over the stove, which was very time consuming and could very easily damage the instrument. The Ekman-Merz current meter was used only on the warmest days, which were very few, and the results obtained were not considered very reliable. The results of current observations are presented in Table 5.

An attempt is being made to interpret the results of the current observations, and they may be published at a later date.

METHODS OF DATA ANALYSIS

No analysis was attempted on the ice station except for an occasional check of the temperature measured by the reversing thermometers against those from the bathythermograph slides. All field log sheets and chlorinity samples were shipped by air to the oceanographic laboratory which had previously been set up at the Arctic Research Laboratory at Point Barrow.

At the laboratory, all protected and unprotected reversing thermometer readings were corrected, and the salinities were titrated. Dynamic depths were computed and sigma-t values were determined as rapidly as the salinity data became available. The anomalies of specific volume and the geopotential anomalies in dynamic meters were computed and all of the diagrams were constructed at the Department of Oceanography of the University of Washington. In most cases, a deep station (4 - 1200 meters) using standard depths was followed immediately by a detailed station sampling the layer between 40 and 150 meters at 5 meter intervals. Vertical distribution curves of temperature and salinity were constructed for each station and are included in this report. When a standard deep station and a detailed station were associated with each other, the data was combined on the curves and both station numbers appear on the drawing. The data from the combined stations has been plotted on temperature-salinity diagrams also.

DESCRIPTION OF PHYSICAL PROPERTIES

Distribution of Temperature

The vertical temperature profile from 4 to 1200 meters along the track of ARLIS I is given in Figure 3. (Location of profile is shown on Figure 2.) The profile lies between 74° N - 75° N and 140° W - 170° W. The water just below the four meter thick ice was considered the surface layer. Surface temperatures were at all places only slightly above the freezing point of sea water. Along the eastern part of the track, and earlier in the season, surface temperatures were between -1.56° C and -1.60° C. As the season progressed and ARLIS I drifted

further west, surface temperatures decreased slightly to a low of -1.65° C between stations 33 and 56 (during the month of November). From this point west to station 67 (26 December 1960), the surface temperatures increased to a high of -1.43° C at station 67. Between stations 67 and 105 (21 February 1961), surface temperatures were between -1.50° C and -1.56° C decreasing towards the west. From 21 February 1961 (station 105) to the end of the track on 11 March 1961 (station 117), surface temperatures further lowered to between -1.61° C and -1.72° C.

The temperature of the water at 50 meters depth decreased more rapidly than that of the surface layer from the middle of January to the middle of March (stations 81 to 117), being everywhere measured less than -1.61° C and reaching a low of -1.75° C on 2 March 1961 at station 111.

The upper 150 meters of water exhibited the same general temperature characteristics along the entire ARLIS I profile. (See vertical temperature distribution curves.) The very surface layer was slightly above the freezing point for its salinity, below this there was slight cooling which was especially pronounced in the western end of the profile. Below about 40-50 meters depth, the water increased in temperature, reaching a maximum of -1.0° C in the east and -1.5° C in the west at 75 to 80 meters depth. Below 80 meters the water cooled to minimum temperatures of from greater than -1.4° C in the east to less than -1.6° C in the west at about 150 meters depth. As stated above, this general structure was maintained along the whole profile from east to west while the entire system cooled somewhat

(except for the surface layer) as winter progressed. The cooling of the layer at 40 - 50 meters depth became more pronounced than the cooling of the waters above and below. (See Figure 4 for detail of temperature between 40 and 150 meters depth.)

The water below 150 meters depth gradually warmed to a maximum of from +0.48° C to +0.50° C at a depth of about 500 meters. Below 500 meters, the temperature decreased until values of -0.19° C or -0.20° C were reached at a depth of 1200 meters. The temperature profile between 150 meters and the deepest layer sampled at 1200 meters varied to such a minor degree that it may be essentially considered constant along the entire ARLIS I track.

An enlargement of the temperature distribution between 40 and 150 meters depth is shown on Figure 4 (which was drawn along the same profile as Figure 3) and on the vertical temperature distribution curves of the detailed stations. This layer was sampled at five meter intervals and enlarged in order to give greater detail of the very interesting temperature structure observed there. The isotherms presented in Figure 4 warmer than -1.4° C have arbitrarily been drawn heavier than those colder than -1.4° C to better illustrate the gradual cooling of the entire layer and the "tongue-like" configuration of the warm layer which developed between September and March as ARLIS I traveled from 140° West to 170° West longitude.

Distribution of Salinity

The distribution of salinity with depth (4 - 1200 meters) along the same line used in constructing the temperature profiles is shown in Figure 5.

The surface salinity had a maximum variation of about 2.50 °/oo. The highest salinity values occured in November in the region of station 51 and the lowest in January near station 75. Proceeding along the ARLIS I salinity profile from east to west, we found that surface salinities of slightly less than 29.0 °/oo on the eastern end of the profile gradually increased to a maximum of 30.1 °/oo at station 51 (74°03.3'N, 152°10.0'W), and then gradually decreased to a minimum of 27.6 °/oo at station 75 (74°35.3'N, 162°42.5'W). Continuing on westward from the area of the minimum surface salinities, values gradually increased again until a salinity of 29.7 °/oo was observed at station 117 (74°50.5'N, 167°07.0'W) in the middle of March, 1961.

Vertical salinity distribution was very constant throughout the track of ARLIS I during the winter season 1960-61. The greatest variations observed were those of the surface layers noted above.

A surface layer of isohaline or nearly isohaline water was present at most stations which varied from about 30 meters thick at the eastern end of the track to about 10 meters thick near the western end of the track. Below the isohaline layer, a strong halocline was present at all stations. Salinities increased sharply from 28.0 °/oo

or 30.0 ‰ to 34.0 ‰ or 34.5 ‰ between the surface layer and 250 meters depth. From 250 meters to 400 or 500 meters the salinity increase was slight, usually increasing from 34.5 ‰ to a maximum of about 34.9 ‰. From 400 or 500 meters to 1200 meters depth the salinity values remained very constant at 34.88 ‰ or 34.90 ‰.

Salinities were obtained and plotted at five meter intervals from a depth of 40 meters down to 150 meters. The vertical salinity distribution within this layer has been enlarged for greater detail and plotted along the same profile as Figures 3, 4 and 5. This enlarged salinity profile is shown in Figure 6.

A PRELIMINARY DISCUSSION OF THE OCEANOGRAPHY

The Navy Hydrographic Office (1958) compiled a chart illustrating all of the known drift patterns of the various ships and ice stations in the Arctic Ocean. From a study of this chart it is believed that the drift of these ships and ice stations conforms to the direction of surface current flow. The drift patterns within the Beaufort Sea, between Alaska-Canada and the North Pole, indicate the presence of a large anticyclonic gyral. Coachman and Barnes (1961) studied the Beaufort Sea circulation in more detail and they pointed out, on page 151, that the dynamic topography of the Beaufort Sea "is in excellent agreement with the observed drift of ice, both as to direction and velocity."

The drift track of ARLIS-I crossed the southernmost portion (the east to west current movement) of the anticyclonic Beaufort Sea gyral. The characteristics of the overall drift pattern of ARLIS I and the water columns studied as the area was traversed are consistant with conditions reported previously by other investigators in the area.

Based on the drift of ice stations T-3, Alpha and Charlie to which the drift of ARLIS I has been added, Figure 1 illustrates the location of the Beaufort Sea gyral and shows the relative areas of investigation which each floating ice station has covered.

ARLIS I drfited a total of about 920 miles in 174 days; this was an average velocity of 12.4 cm/sec. Some of this movement was undoubtedly due to the effect of local winds which at times were very strong, but the dominant westerly drift of the ice floe is believed to be related to the currents of this section of the Beaufort Sea gyral. The total westerly component of movement was about 540 miles in 174 days. This was an average westerly velocity of 6.6 cm/sec from start to finish. The measured average velocity of 6.6 cm/sec agreed perfectly with the velocities derived from the dynamic topography of Coachman and Barnes (1961, p. 152).

From an examination of temperatures, salinity and sigma-t diagrams in this report, a number of structural features are apparent. There appear to be three distinct types of water readily distinguishable from the diagrams which are described below in some detail.

A surface layer of Arctic water extends down to about 40 meters. Temperatures in this layer are just above freezing and salinity values are relatively low (27.6 - 30.1 ‰). One would expect temperatures to decrease and the low surface salinities of early fall resulting from dilution by summer melt water, to increase as the winter season progressed. This appears to be the case for the period from September through November because surface

salinities increased from 29.0 to 30.1 ‰, and temperatures decreased from -1.56° C to -1.65° C by the end of November. During the month of December, however, when freezing was very active, surface salinities decreased to a low of 27.6 ‰ and temperatures increased to a high of -1.43° C. Later, in January, salinities began to increase and temperatures to decrease once more and continued until salinities reached a value of about 29.7 ‰ and temperatures were lowered to -1.72° C by the middle of March.

Gast (1959) also noticed this reversal in the expected surface temperature - salinity trend on Station Charlie. He postulated that advection of dilute surface waters into this area may be greater than the rate of freezing.

In the layer from 200 or 250 meters to 1200 meters depth the water column was very similar at all stations occupied. Salinities gradually increased to about 34.9 ‰ and the temperature of the water warmed to a maximum of 0.5° C at 500 meters. Below the depth of 500 meters, salinity was very stable, remaining at about 34.9 ‰ all the way to 1200 meters, and the temperature decreased slowly reaching 0° C at 1000 meters and a minimum of about -0.2 ° C at a depth of 1200 meters. The concensus of opinion (e.g. Nansen, 1902; Timofeyev, 1957, 1958; Coachman and Barnes, 1961) is that this layer of water is definitely of Atlantic origin. The deepest water, with temperatures less than 0° C, is also of Atlantic origin and believed to be "formed only during winter and only in limited geographic areas in the Norwegian Sea" (Coachman and Barnes, 1961, p.150).

Separating the surface and Atlantic layers described above was a third layer of water. It is hereafter referred to as the intermediate layer. The intermediate layer was characterized by a temperature maximum and minimum and a very strong halocline and pycnocline. The water column between 40 and 140 meters depth was sampled at 5 meter intervals whenever possible and enlarged cross-sections of temperature and salinity are included in this report (Figures 4 and 6). From about 30 or 40 meters depth, the temperature increased rapidly, reaching a maximum of -1.0°C in the east and -1.5°C in the west at 75 or 80 meters. The temperature then decreased sharply to a minimum of slightly warmer than -1.4°C in the east and less than -1.6°C in the west at about 150 or 200 meters.

The temperature differences within this intermediate layer were not great (less than 0.5°C), but they persist throughout the entire track of ARLIS I. There was a very strong halocline in the intermediate layer where salinities increased from 28 or 29 °/oo to 34 or 34.5 °/oo. In this area, salinity controlled the distribution of density thus the strong halocline gave rise to a very strong pycnocline.

Sigma-t values in the intermediate layer fell between 25.0 and 27.0. (See T-S diagrams in Appendix of this report)

Coachman and Barnes (1961) have noted this layer previously and discussed it at length in their paper. After a thorough study of the characteristics peculiar to the intermediate layer, they have come to the conclusion that it is formed by advection of water from the Bering Sea through the Chukchi Sea, mixing with the Siberian shelf waters as it traveled north and eventually joined the Beaufort Sea gyral northwest of Point Barrow.

Coachman and Barnes (1961, p. 158) believe the entire layer of intermediate water had a similar geographic, but a different seasonal origin; that is, the water of the shallow temperature maximum at 75 to 80 meters "originates as summer Bering Sea water, and the water of the temperature minimum at 150 meters may, in part, originate and be maintained by mixing appropriate amounts of Bering Sea water with shelf water. In this case, bottom shelf water would mix with winter Bering Sea water, and the resulting mixture would be denser and lie below the water of the shallow temperature maximum in the Beaufort Sea gyral."

Bibliography

1. U. S. Navy Hydrographic Office (1958), Oceanographic Atlas of the Polar Seas, H. O. Pub. No. 705, Part II; Arctic, Fig. 12, p. 13.

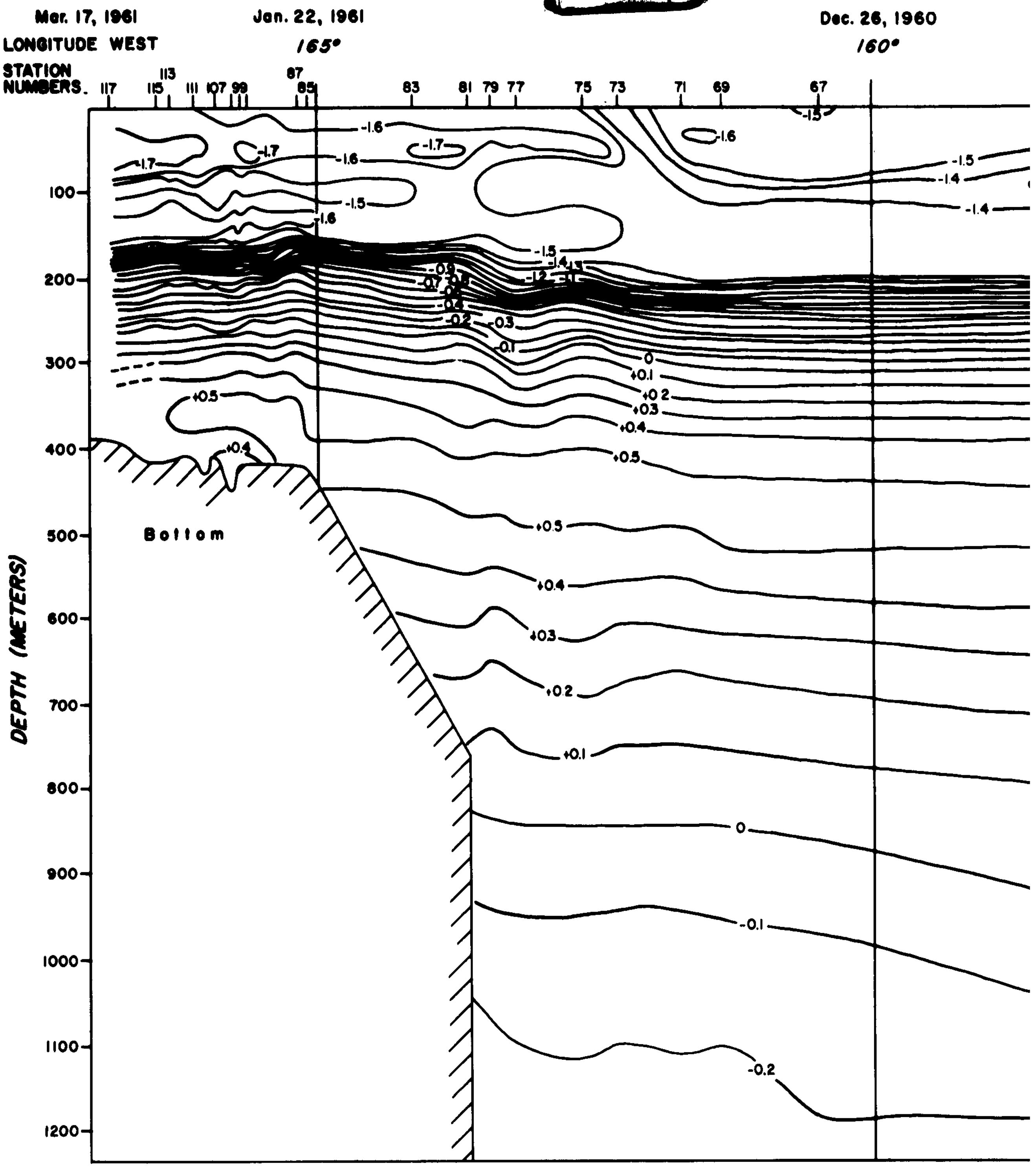
2. Coachman L. K. and Barnes, C. A. (1961) Arctic, Vol. 14, No. 3, pp. 147-161.

3. Gast, James (1959) Oceanography of Drifting Station Charley Semi-Annual Report, Contract Nonr 477(24), T. O. 307-252, Department of Meteorology, University of Washington, pp. 38-40.

4. Nansen, F. (1902) Oceanography of the North Polar Basin Sci. Res. Norweg. N. Pol. Expedition 1893-96 Vol. III, No. 9, pp. 427.

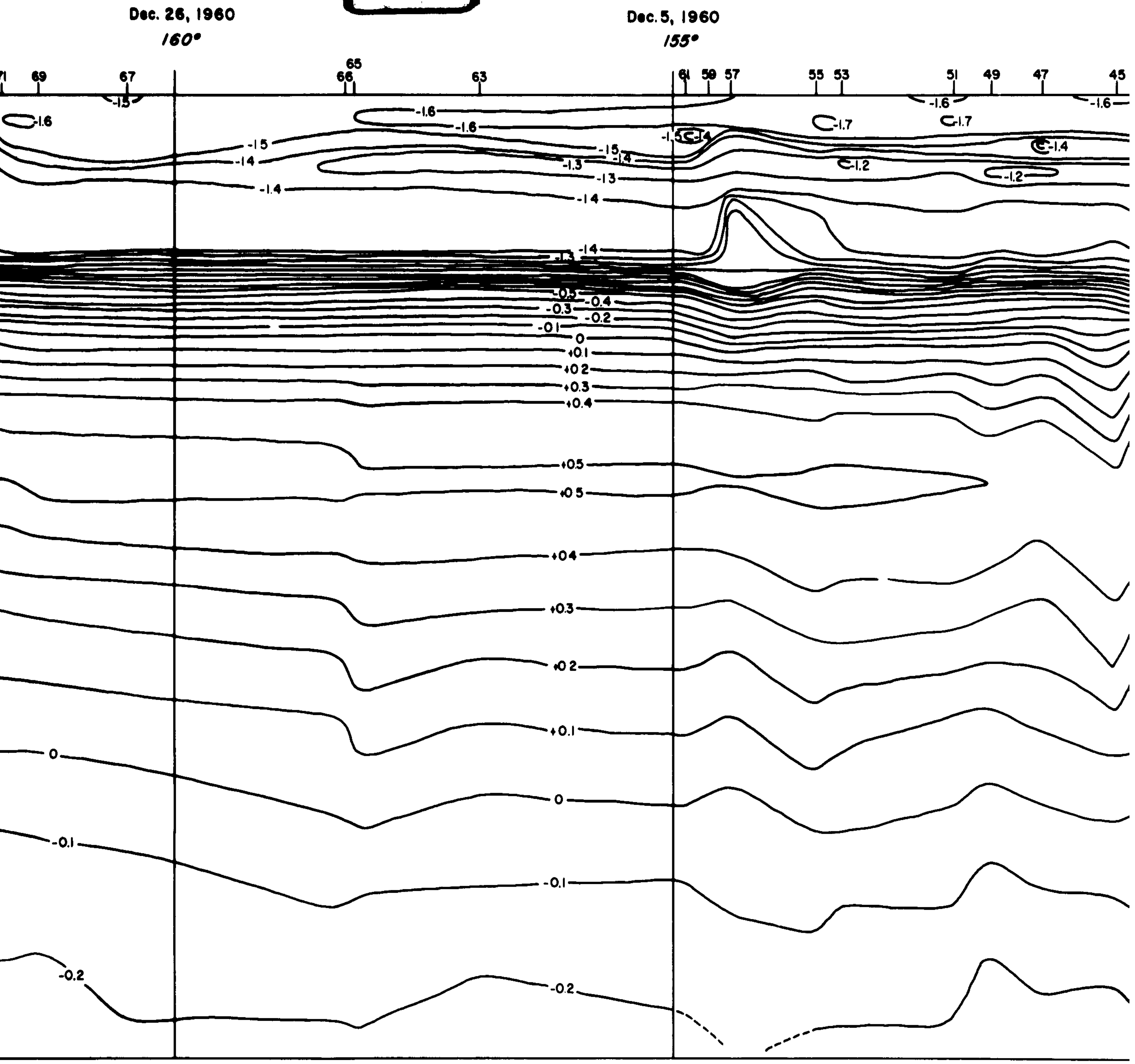
5. Timofeyev (1957) Atlanticheskiye Vodi v arkticheskom basseine. Probl. Arkt. No. 2:41-51.

6. ________ (1958) O "Vosraste" atlanticheskikh vod v arkticheskom basseme. Probl. Arkt. No. 5:27-31.


Mar. 17, 1961
Jan. 22, 1961
Dec. 26, 1960
LONGITUDE WEST
165°
160°
STATION NUMBERS
117 115 113 111 107 99 87 85 83 81 79 77 75 73 71 69 67
DEPTH (METERS)
100
200
300
400
500
600
700
800
900
1000
1100
1200
Bottom
-1.7
-1.6
-1.5
-1.4
-1.3
-1.2
-1.1
-0.9
-0.7
-0.4
-0.3
-0.2
-0.1
0
+0.1
+0.2
+0.3
+0.4
+0.5
-0.1
-0.2

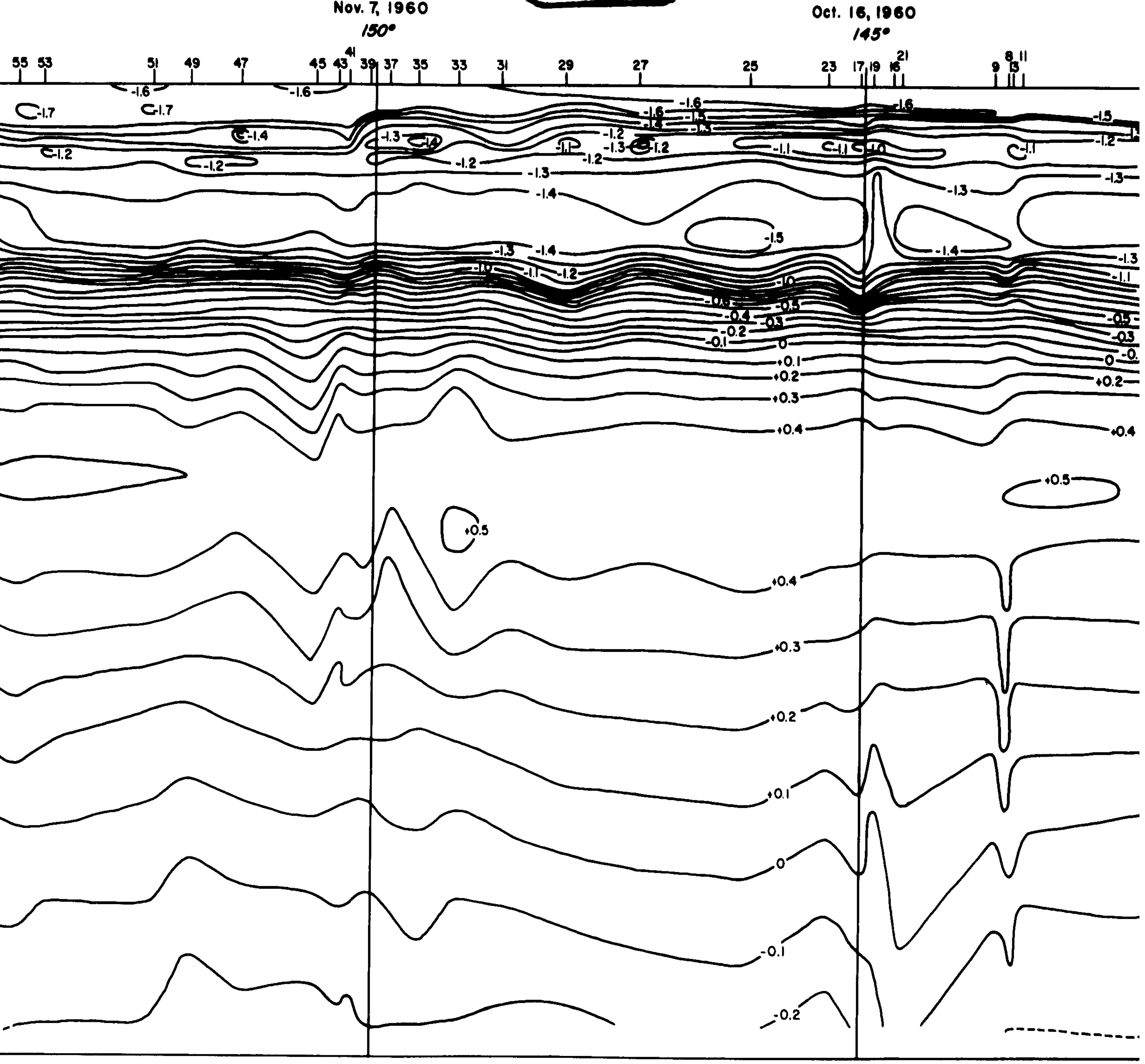
2

ARLIS I-TEMPERATURE PROFILE

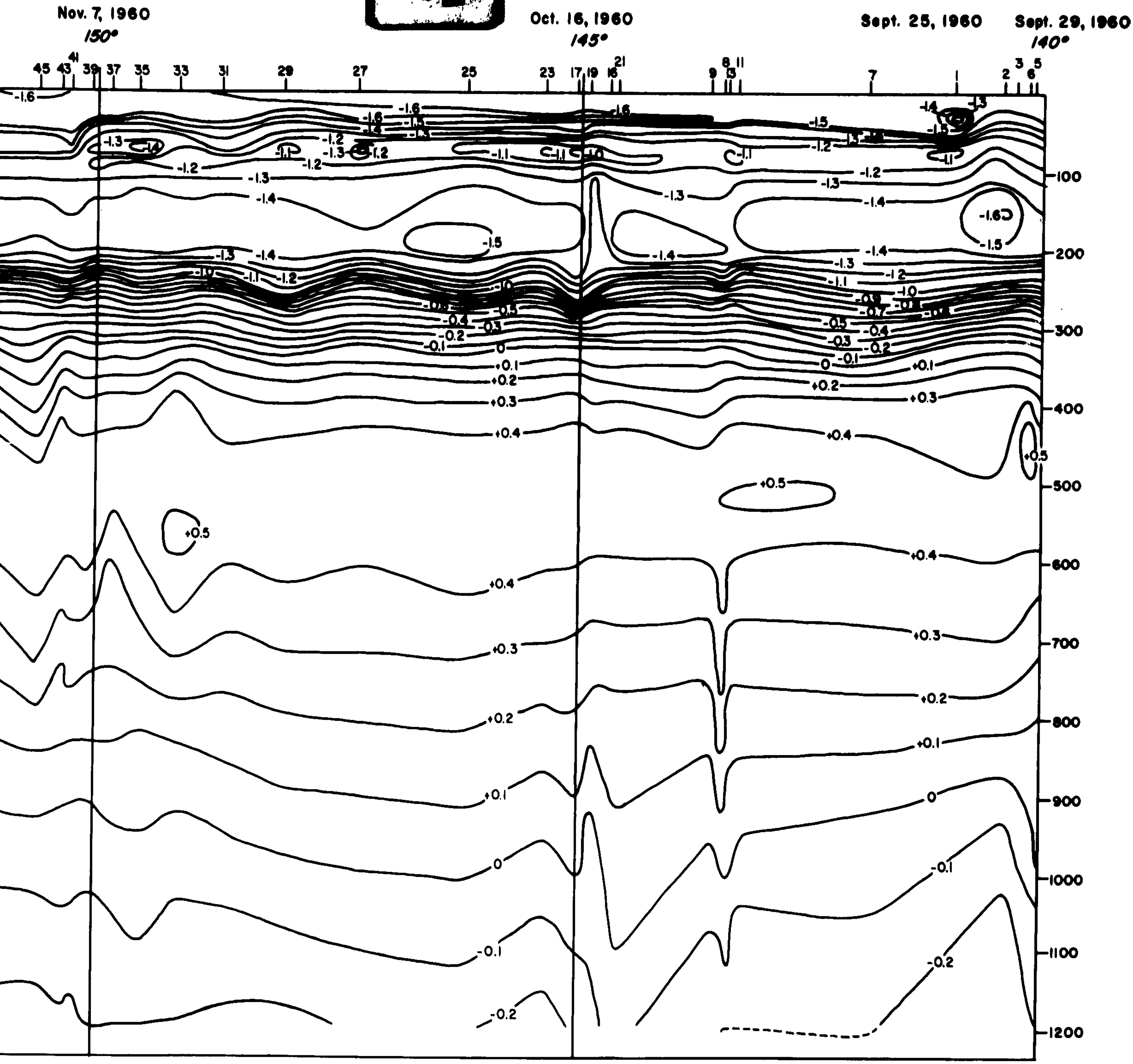


3

TURE PROFILE

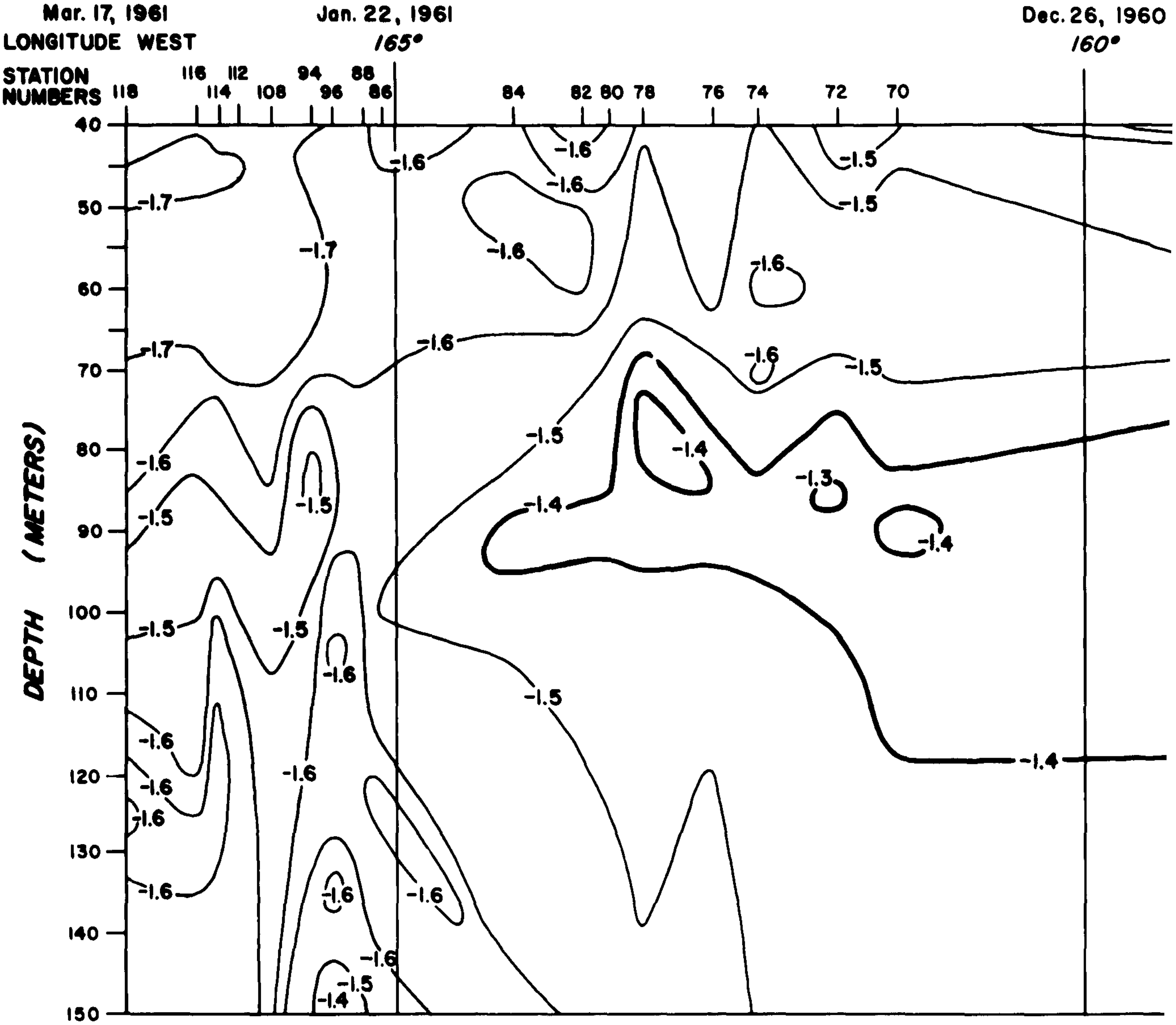


4



Nov. 7, 1960
150°
Oct. 16, 1960
145°
Sept. 25, 1960
Sept. 29, 1960
140°
45 43 41 39 37 35 33 31 29 27 25 23 17 19 16 21 9 8 13 11 7 1 2 3 6 5
100
200
300
400
500
600
700
800
900
1000
1100
1200
-1.6
-1.5
-1.4
-1.3
-1.2
-1.1
-1.0
-0.4
-0.3
-0.2
-0.1
0
+0.1
+0.2
+0.3
+0.4
+0.5

Fig. 3

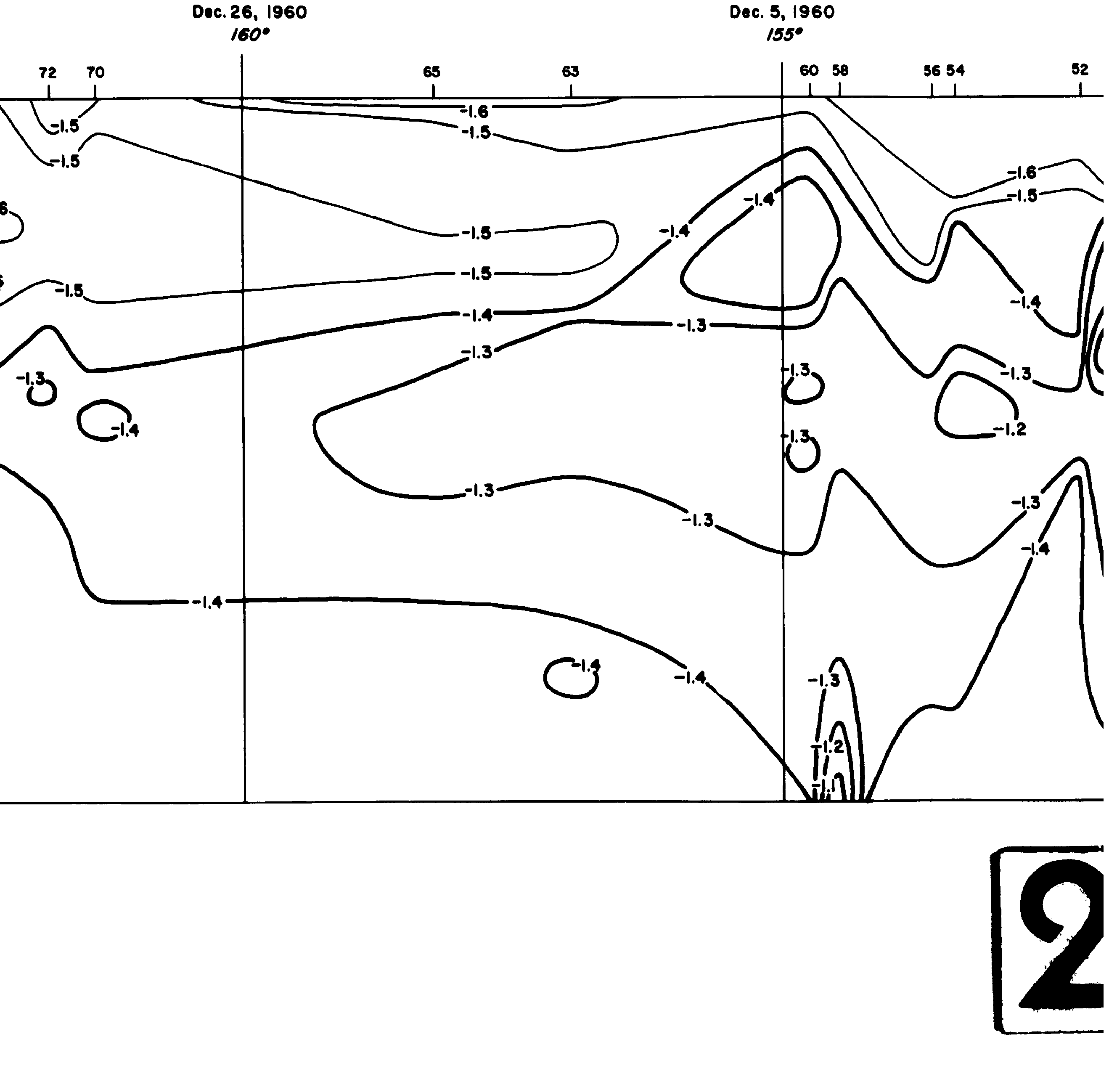


Mar. 17, 1961
Jan. 22, 1961
Dec. 26, 1960
LONGITUDE WEST
165°
160°
STATION NUMBERS
118 116 114 112 108 94 96 88 86 84 82 80 78 76 74 72 70
DEPTH (METERS)
40 50 60 70 80 90 100 110 120 130 140 150
-1.7
-1.6
-1.5
-1.4
-1.3

1

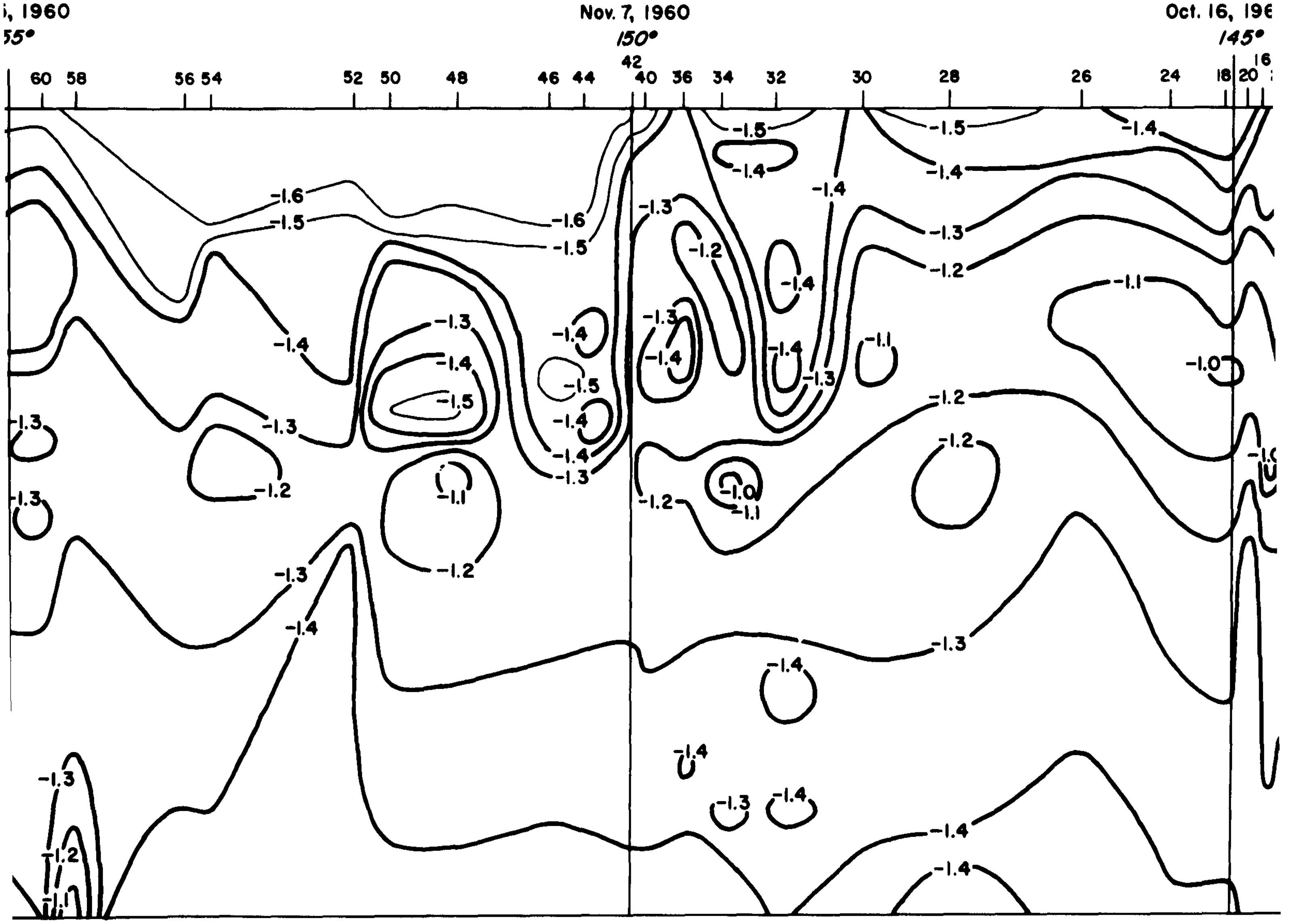
ARLIS I - DETAILED TEMPERATURE

(40 - 150 meters depth)

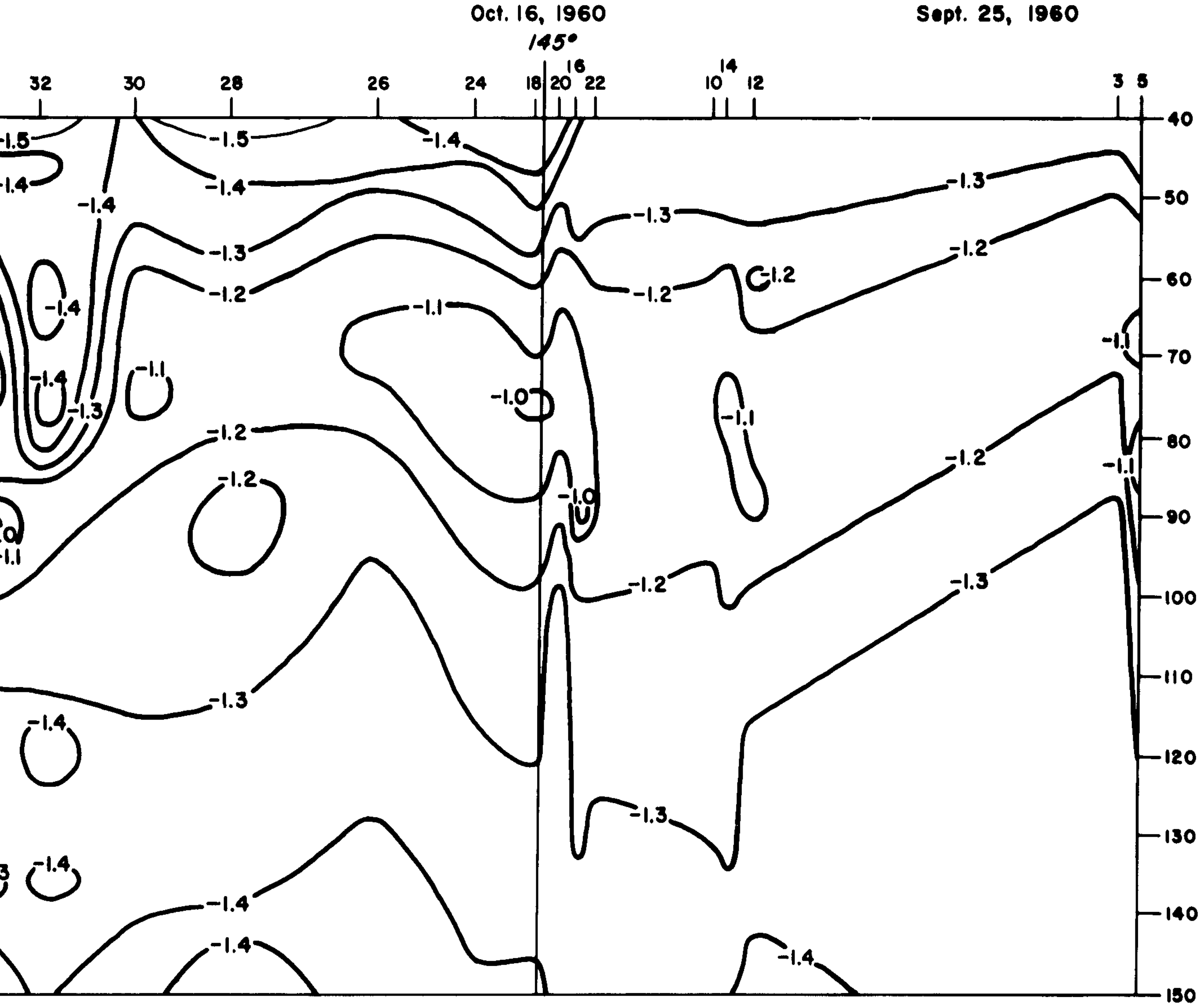


ILED TEMPERATURE PROFILE

-150 meters depth)



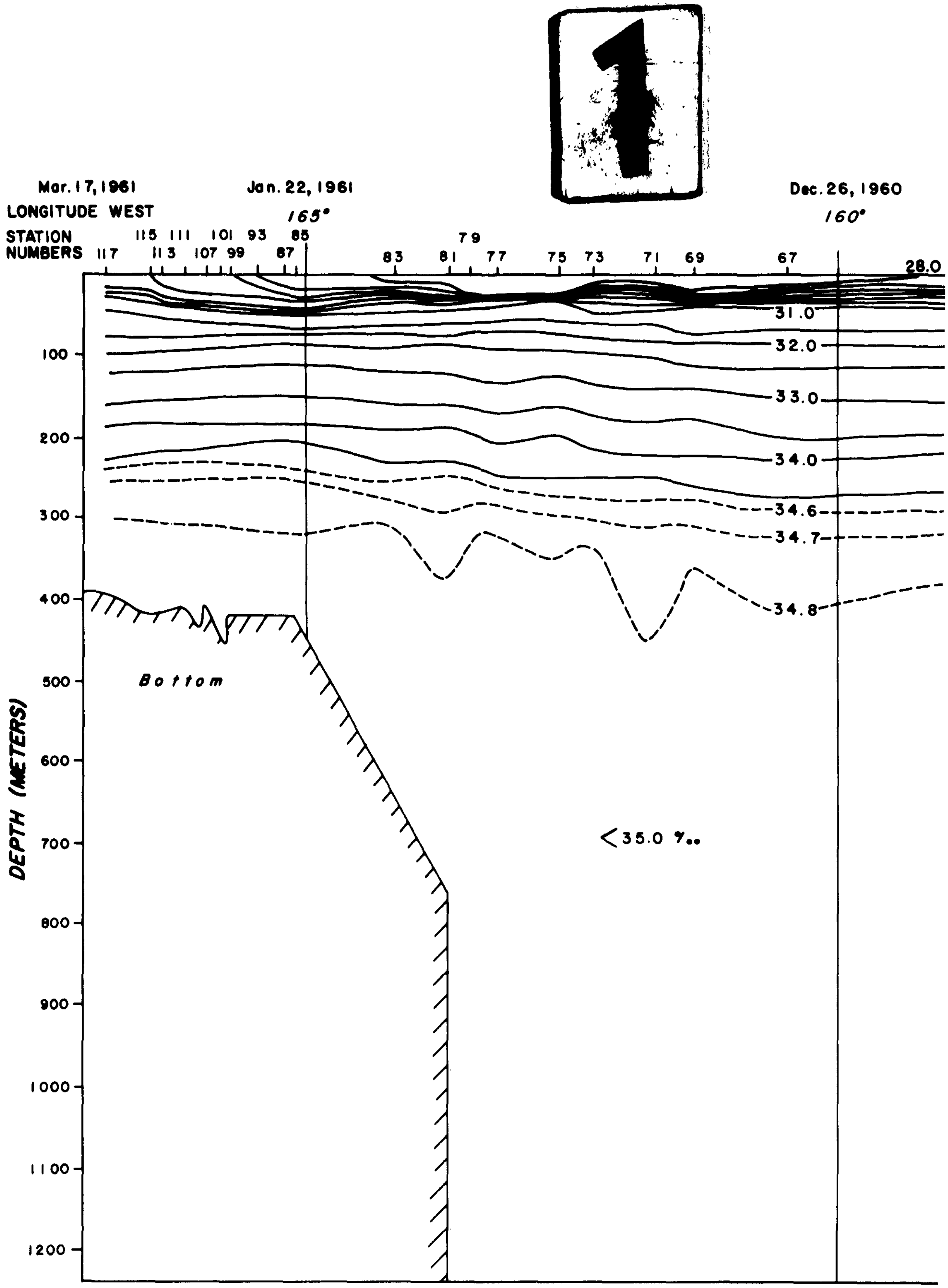
3

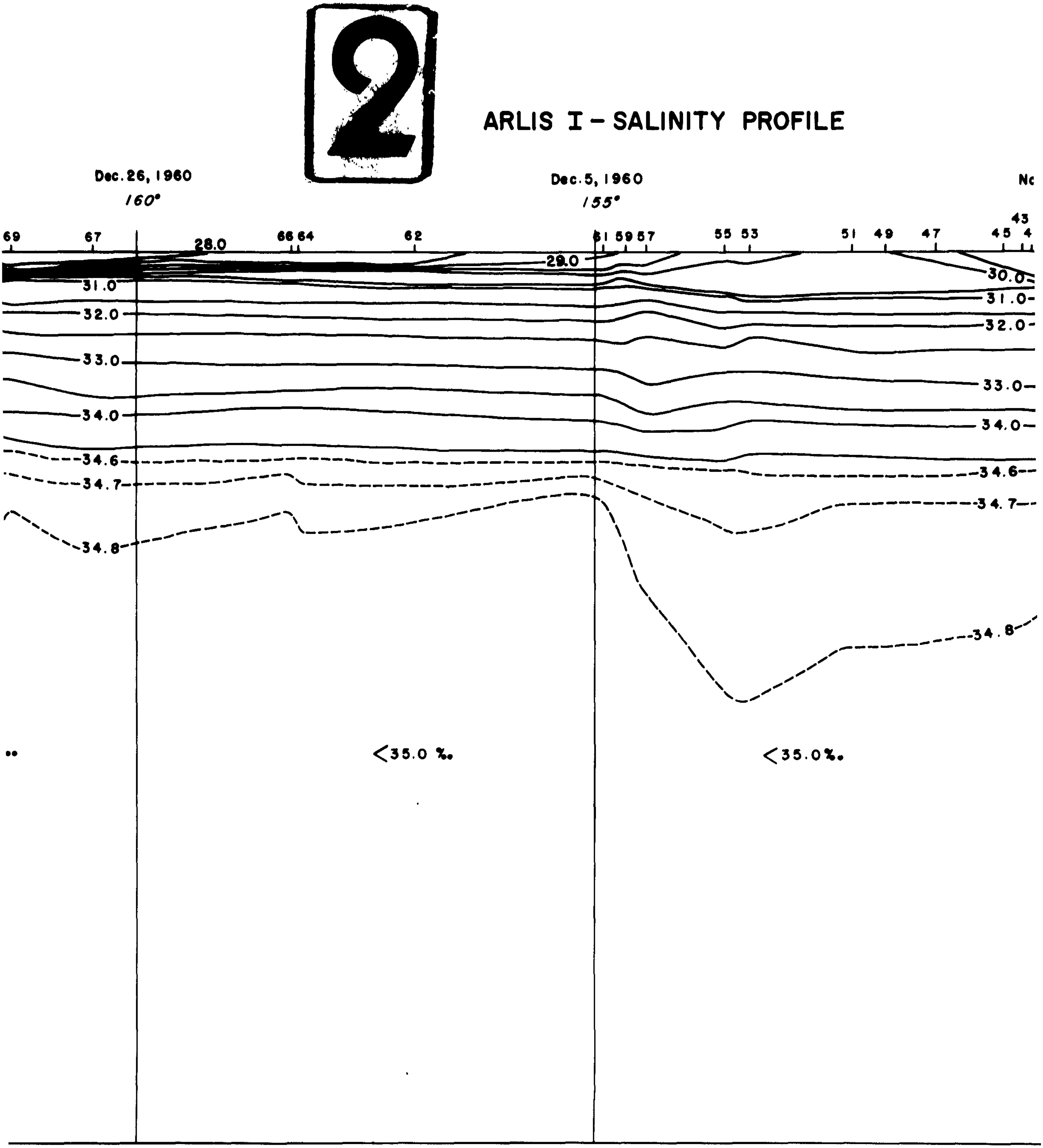


Oct. 16, 1960
145°
Sept. 25, 1960
32
30
28
26
24
18
20
16
22
10
14
12
3
5
40
50
60
70
80
90
100
110
120
130
140
150
-1.5
-1.4
-1.3
-1.2
-1.1
-1.0

Fig. 4

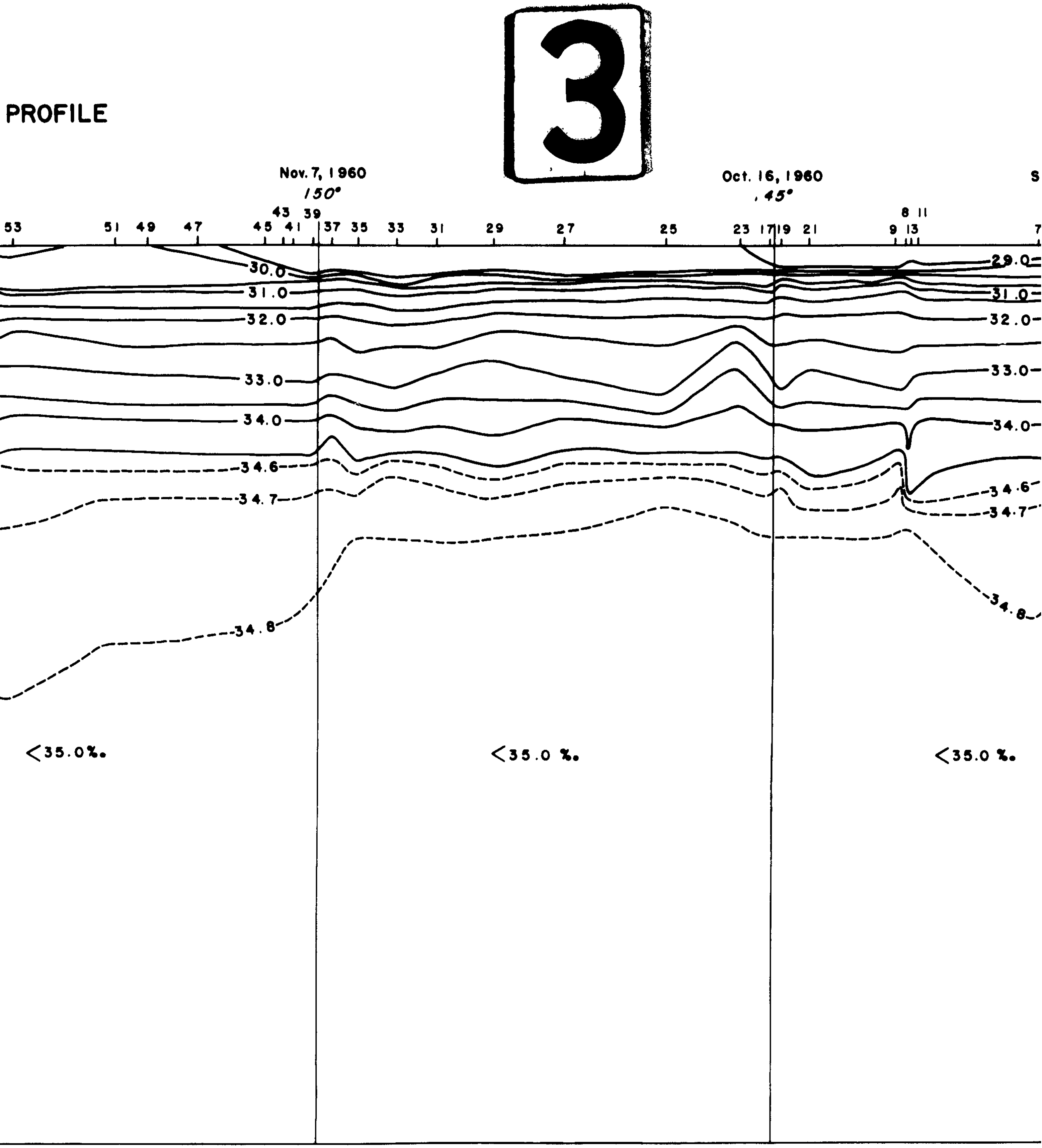
4


1
Mar. 17, 1961
Jan. 22, 1961
Dec. 26, 1960
LONGITUDE WEST
165°
160°
STATION NUMBERS
117 115 113 111 107 101 99 93 87 85 83 81 79 77 75 73 71 69 67
28.0
31.0
32.0
33.0
34.0
34.6
34.7
34.8
Bottom
<35.0 ‰
DEPTH (METERS)
100
200
300
400
500
600
700
800
900
1000
1100
1200



2
ARLIS I - SALINITY PROFILE
Dec. 26, 1960
160°
Dec. 5, 1960
155°
69
67
66 64
62
61 59 57
55 53
51
49
47
45
43
28.0
29.0
30.0
31.0
32.0
33.0
34.0
34.6
34.7
34.8
<35.0 ‰
<35.0 ‰

PROFILE


3
Nov. 7, 1960
150°
Oct. 16, 1960
, 45°
S
53
51
49
47
45
43
41
39
37
35
33
31
29
27
25
23
17
19
21
9
8
11
13
7
30.0
29.0
31.0
32.0
33.0
34.0
34.6
34.7
34.8
<35.0‰
<35.0 ‰
<35.0 ‰

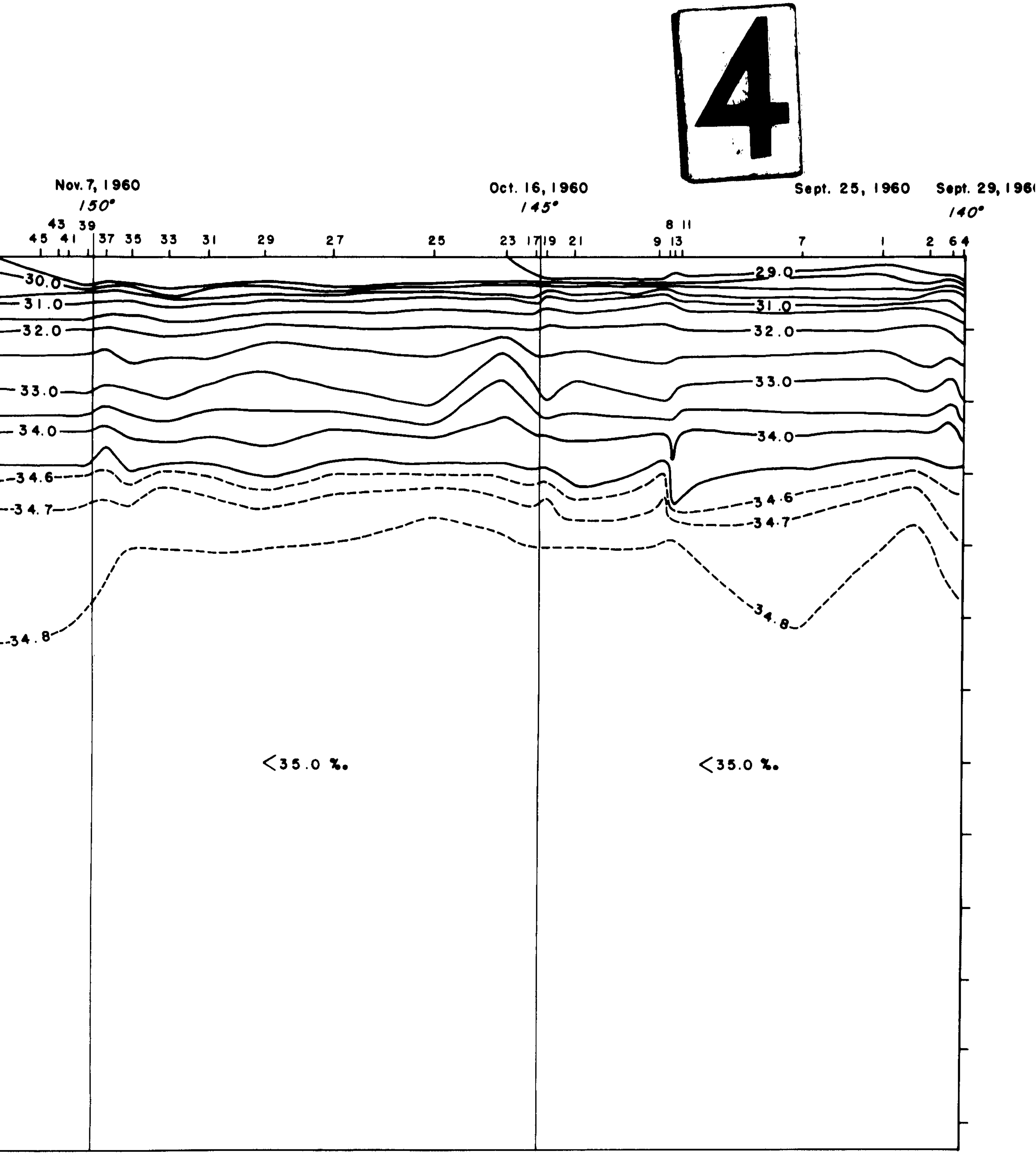
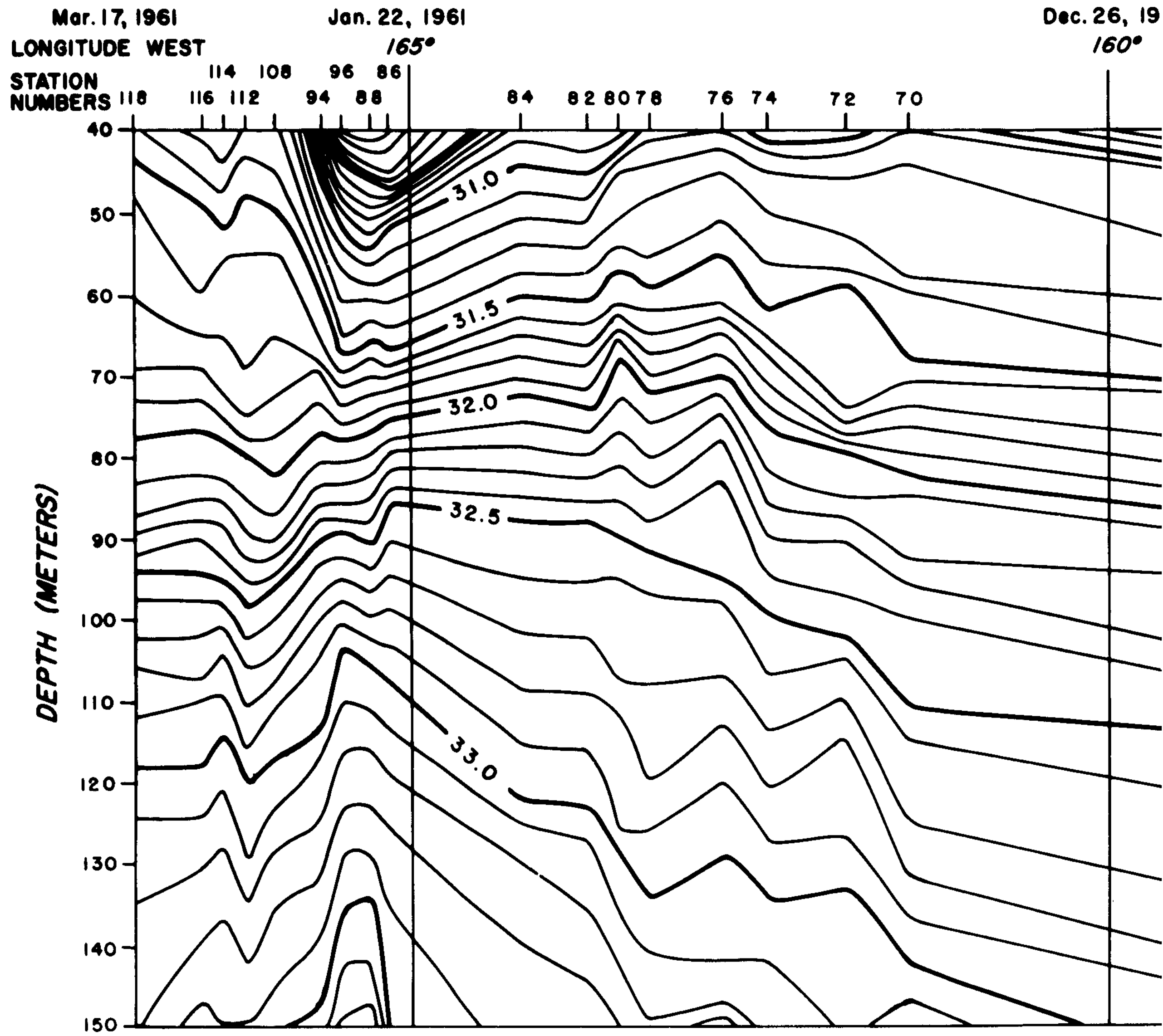
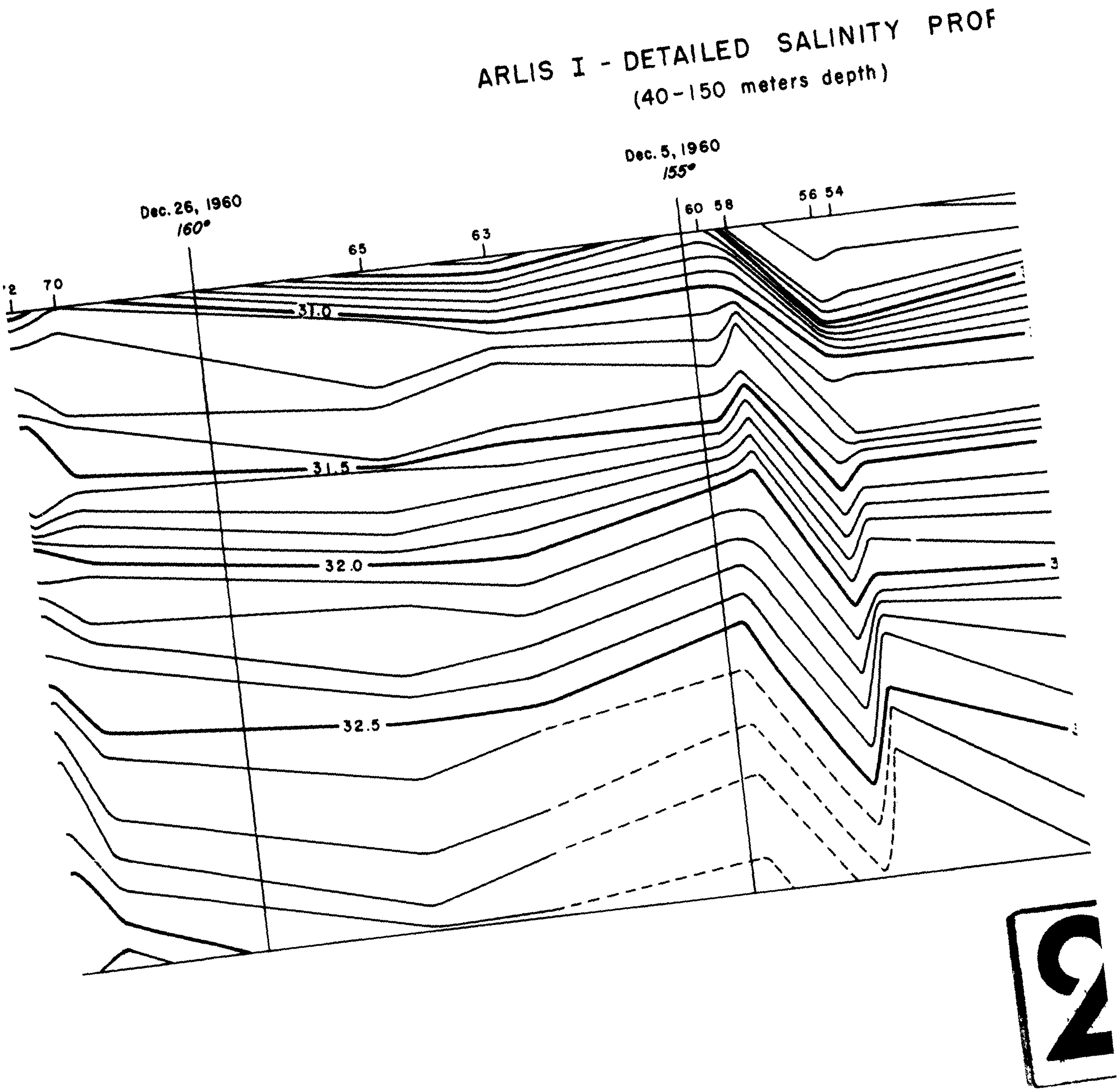

4
Nov. 7, 1960
150°
Oct. 16, 1960
145°
Sept. 25, 1960
Sept. 29, 1960
140°
45 43 41 39 37 35 33 31 29 27 25 23 17 19 21 9 8 11 13 7 1 2 6 4
30.0
31.0
32.0
33.0
34.0
34.6
34.7
34.8
29.0
<35.0 ‰

Fig. 5



Mar. 17, 1961
Jan. 22, 1961
Dec. 26, 19
LONGITUDE WEST
165°
160°
STATION NUMBERS
118 116 114 112 108 94 96 88 86 84 82 80 78 76 74 72 70
DEPTH (METERS)
40 50 60 70 80 90 100 110 120 130 140 150
31.0
31.5
32.0
32.5
33.0

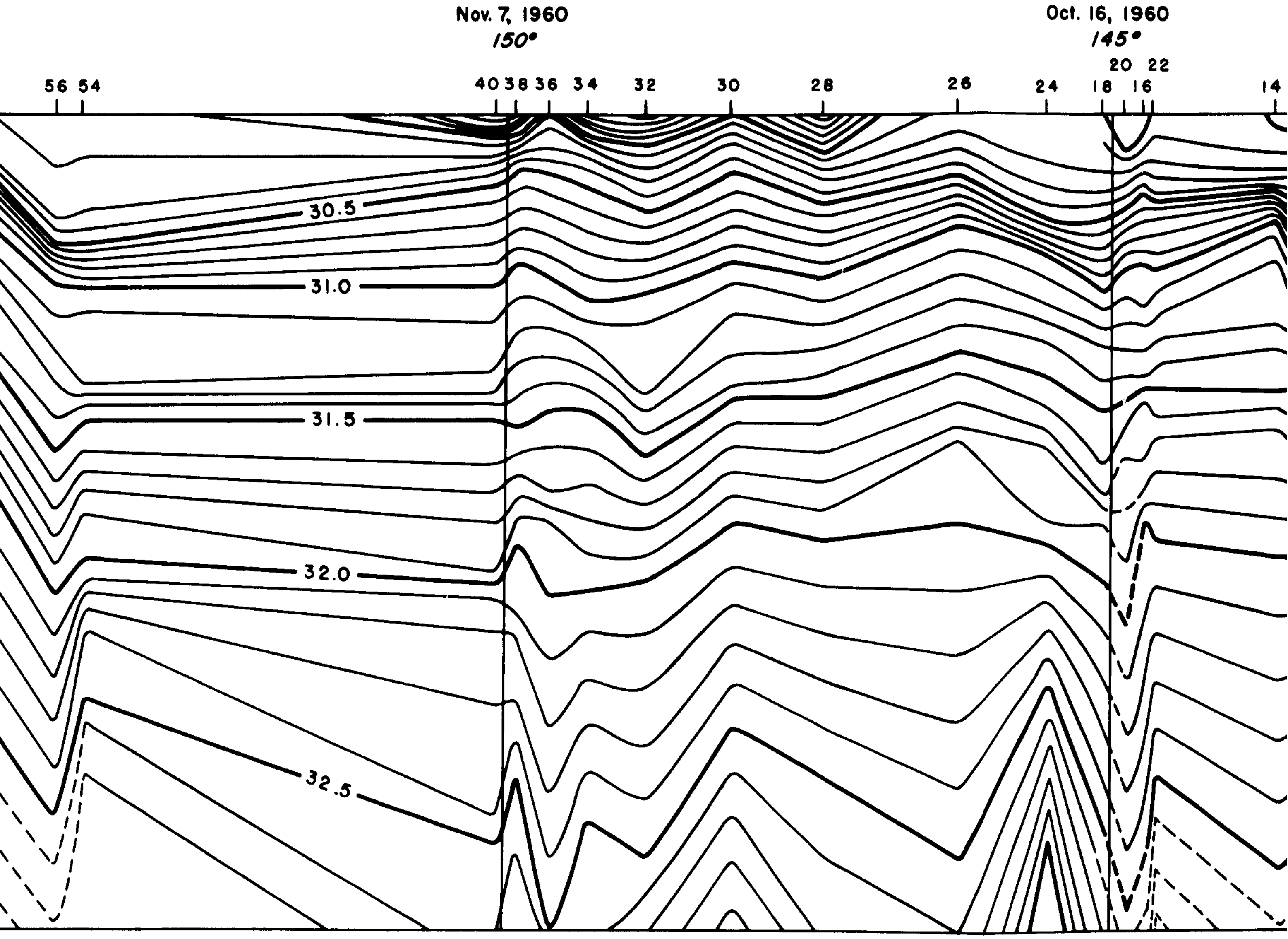
1



ARLIS I - DETAILED SALINITY PROF
(40-150 meters depth)
Dec. 5, 1960
155°
Dec. 26, 1960
160°
70
65
63
60
58
56
54
31.0
31.5
32.0
32.5

D SALINITY PROFILE

neters depth)



3

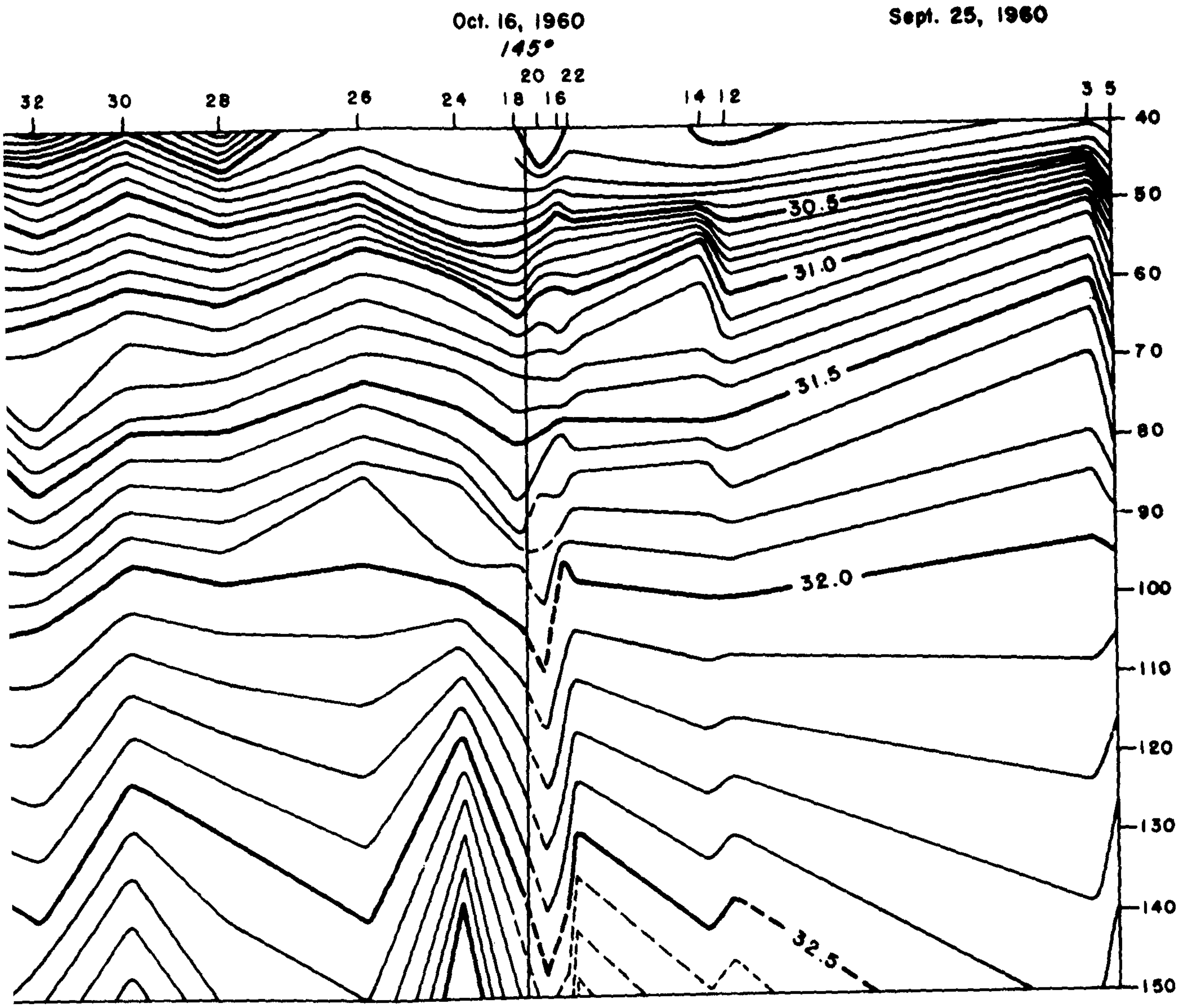
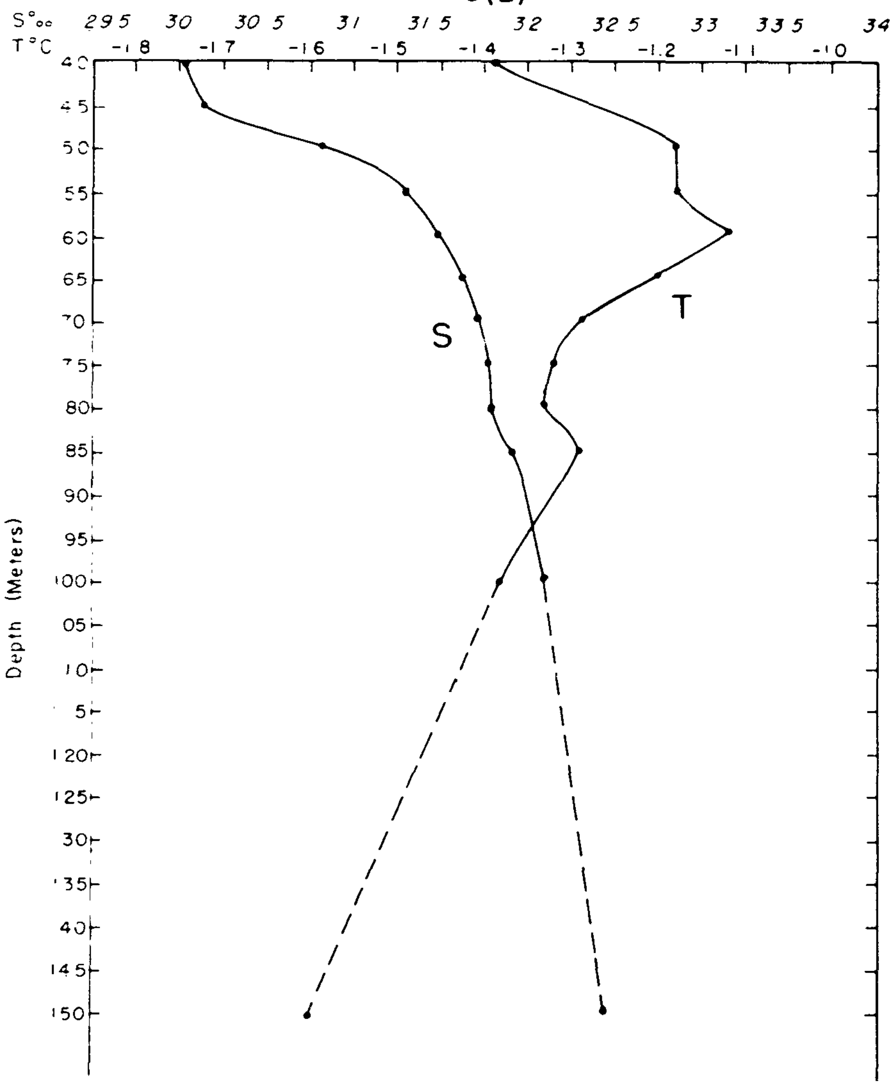

Oct. 16, 1960
145°
Sept. 25, 1960
32
30
28
26
24
18
20
16
22
14
12
3
5
30.5
31.0
31.5
32.0
32.5
40
50
60
70
80
90
100
110
120
130
140
150

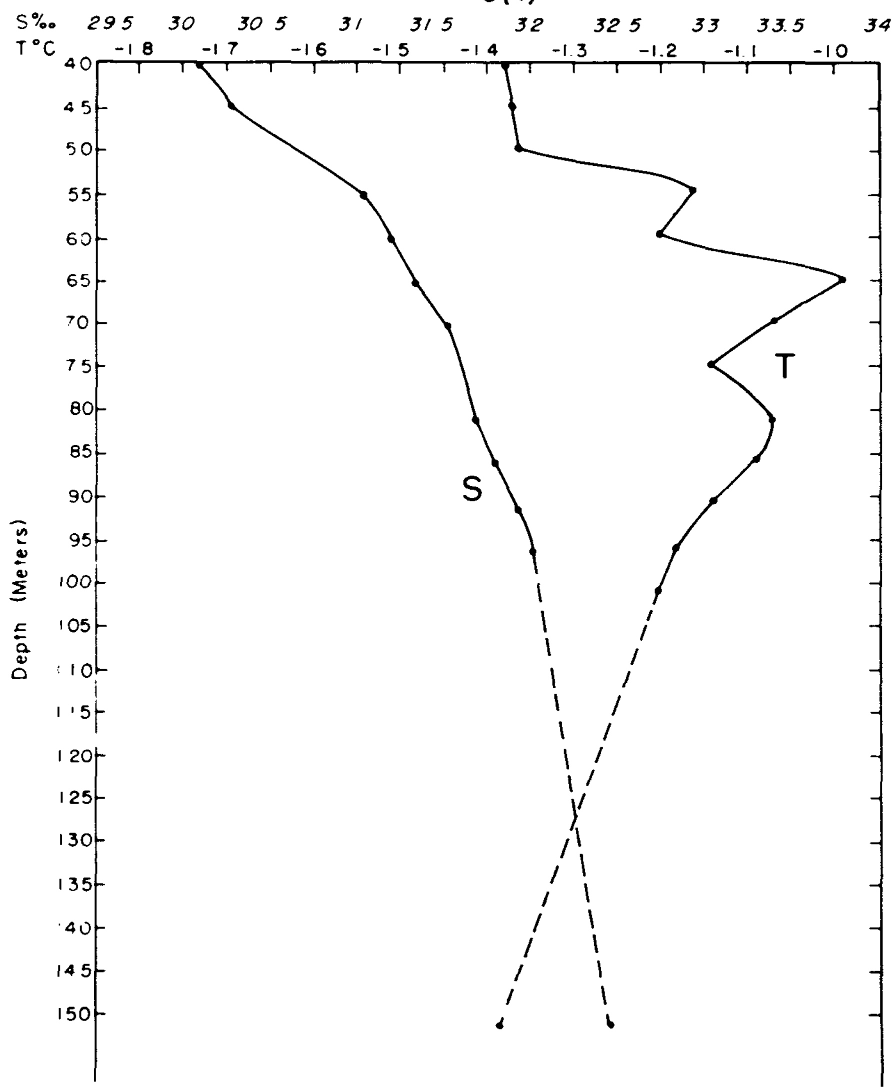
Fig. 6

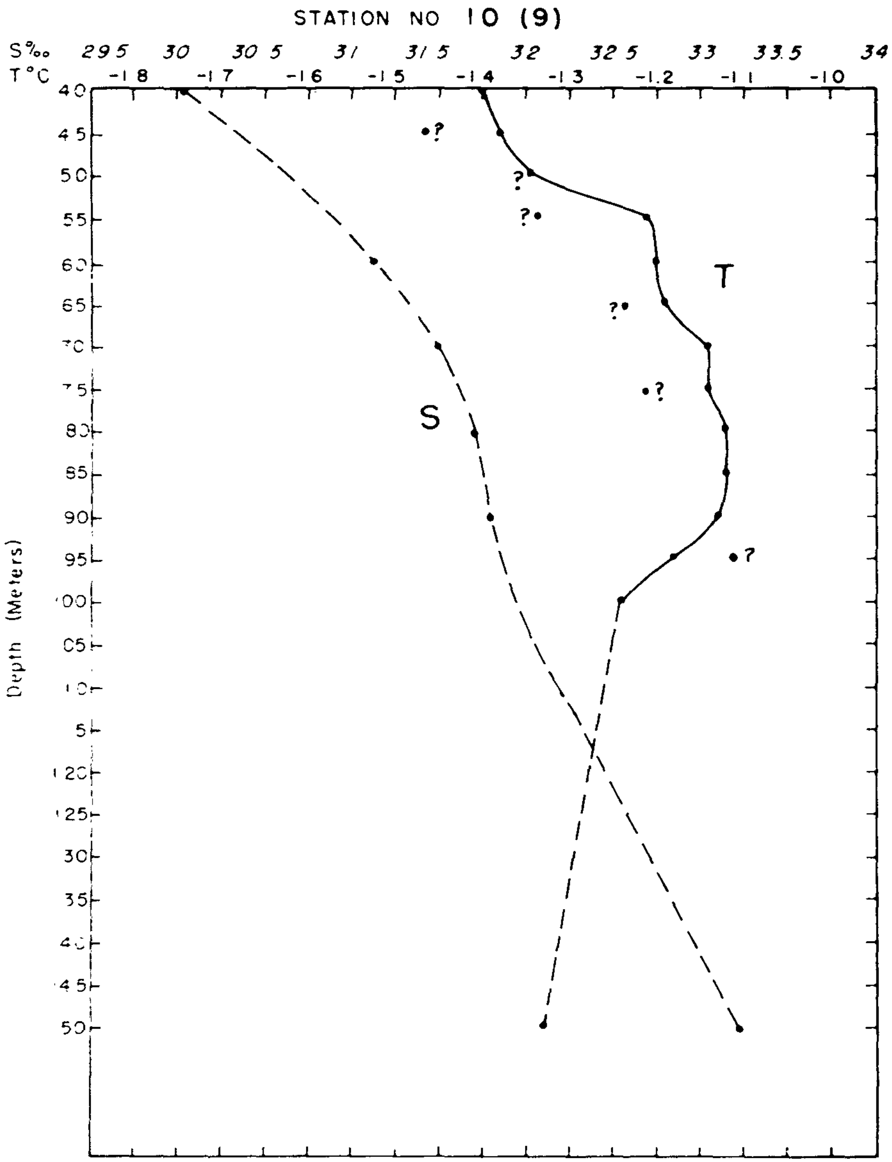
4

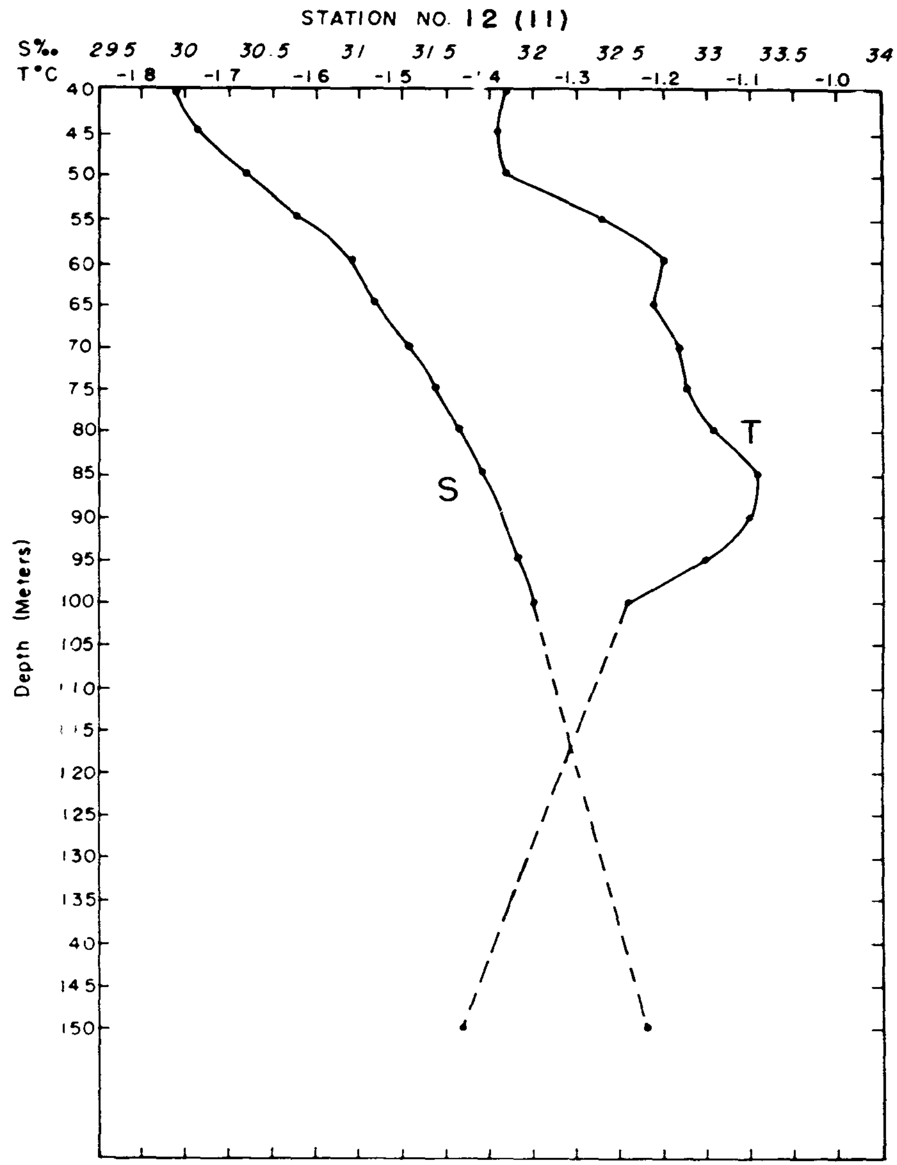
STATION NO 3(2)



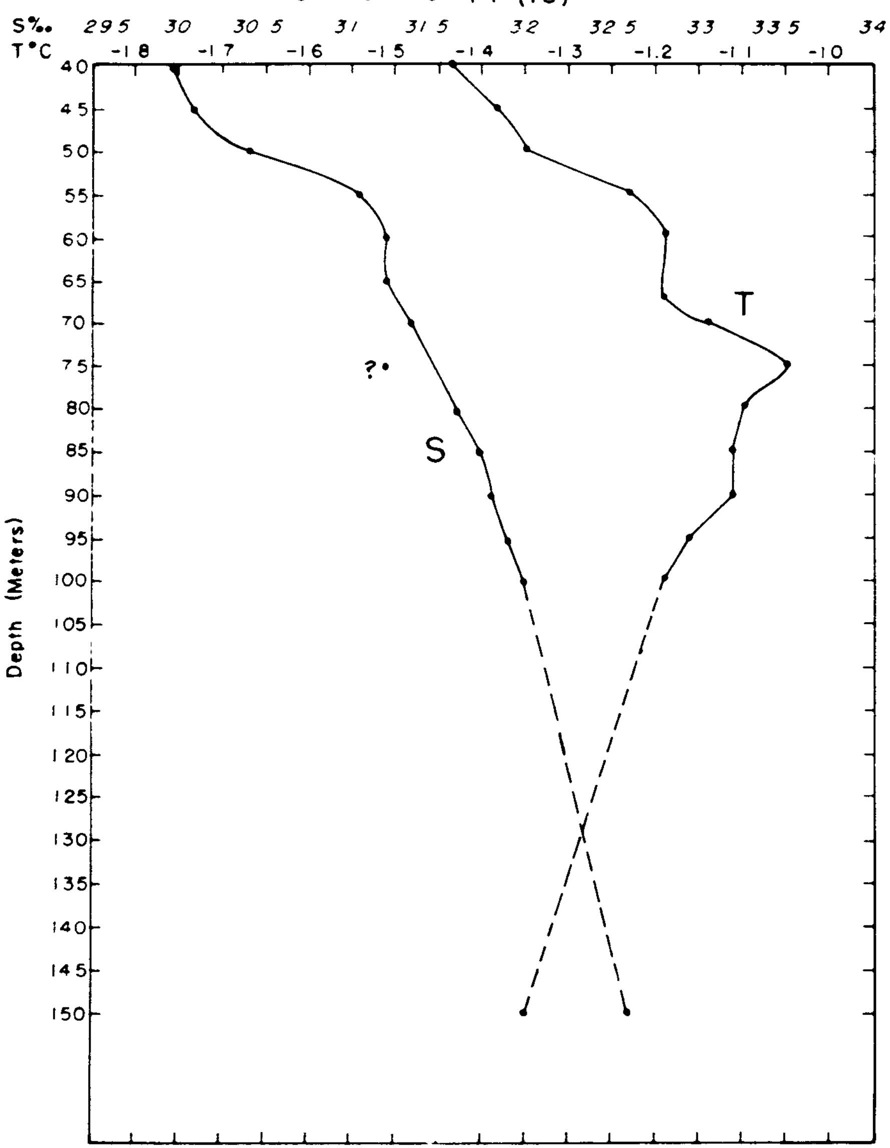
STATION NO 5(4)



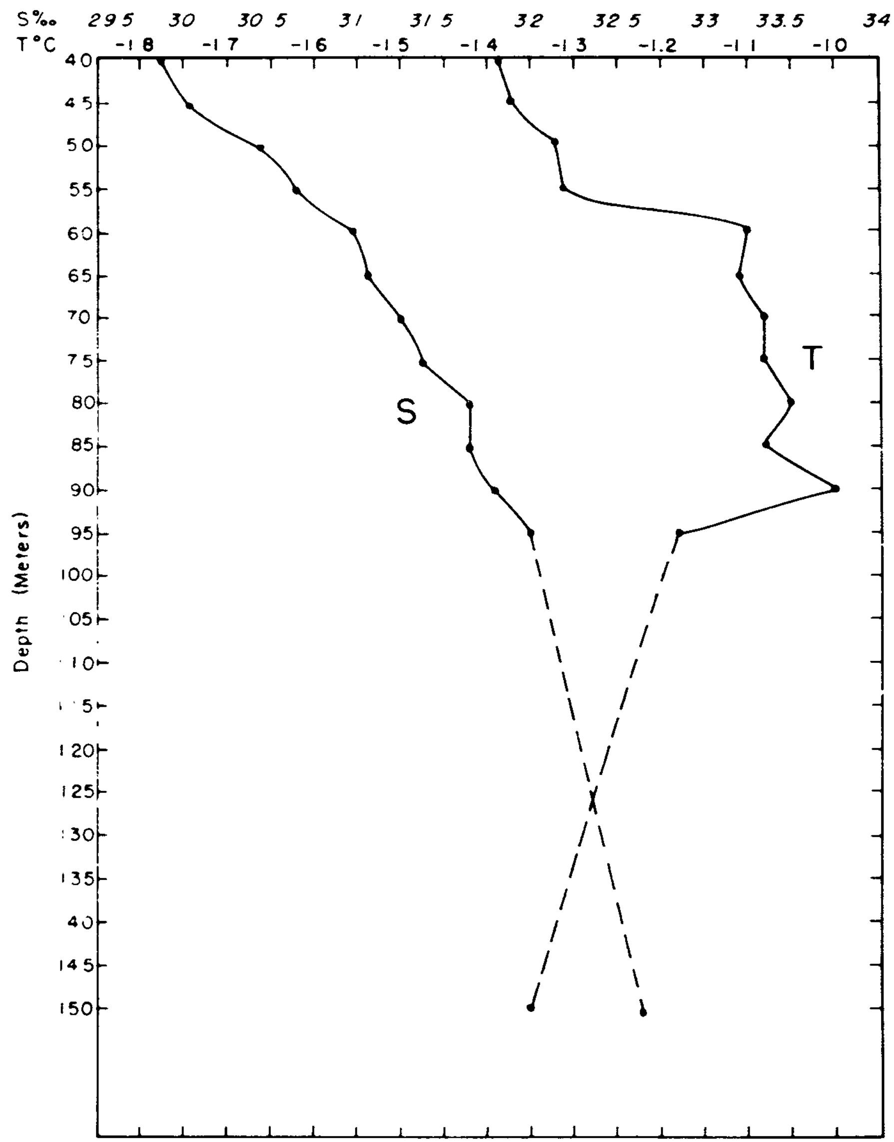

STATION NO 10 (9)
S‰
T°C
Depth (Meters)
T
S

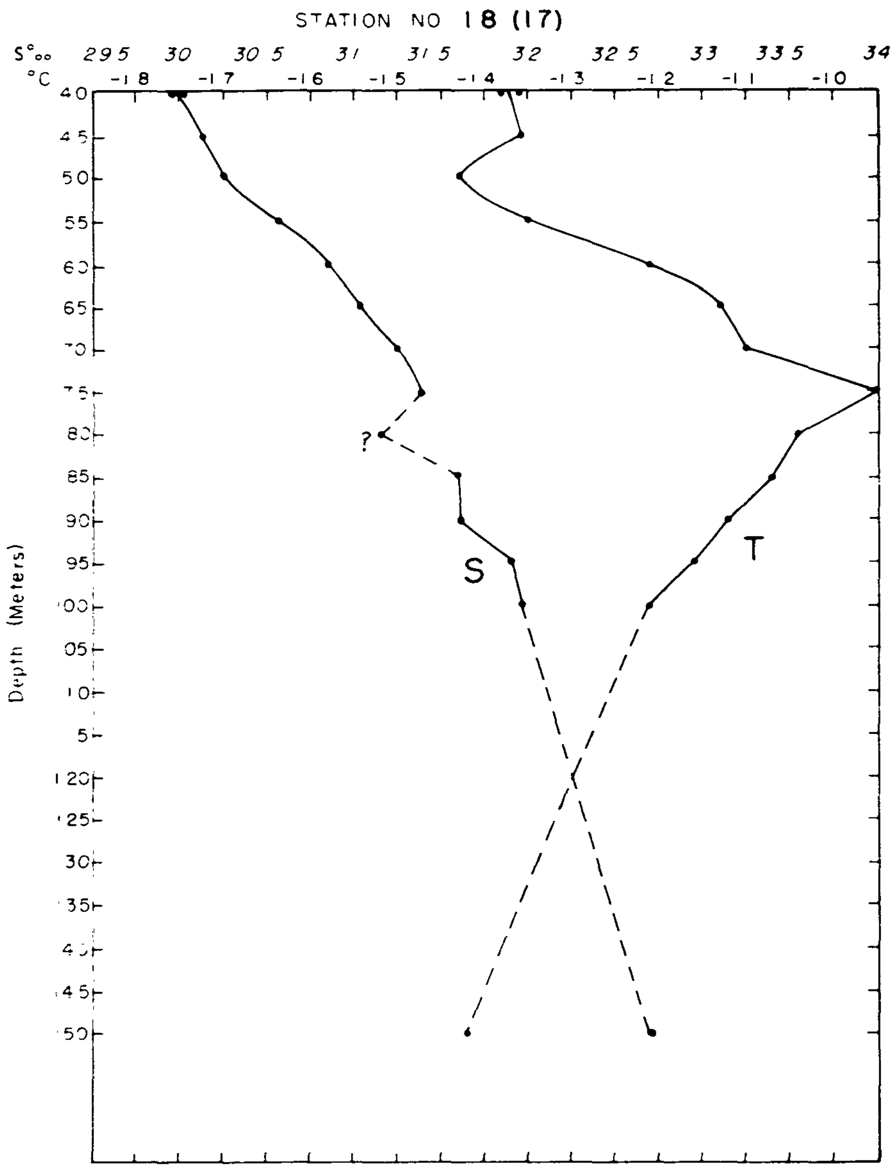

STATION NO. 12 (11)
S‰
T°C
Depth (Meters)
T
S

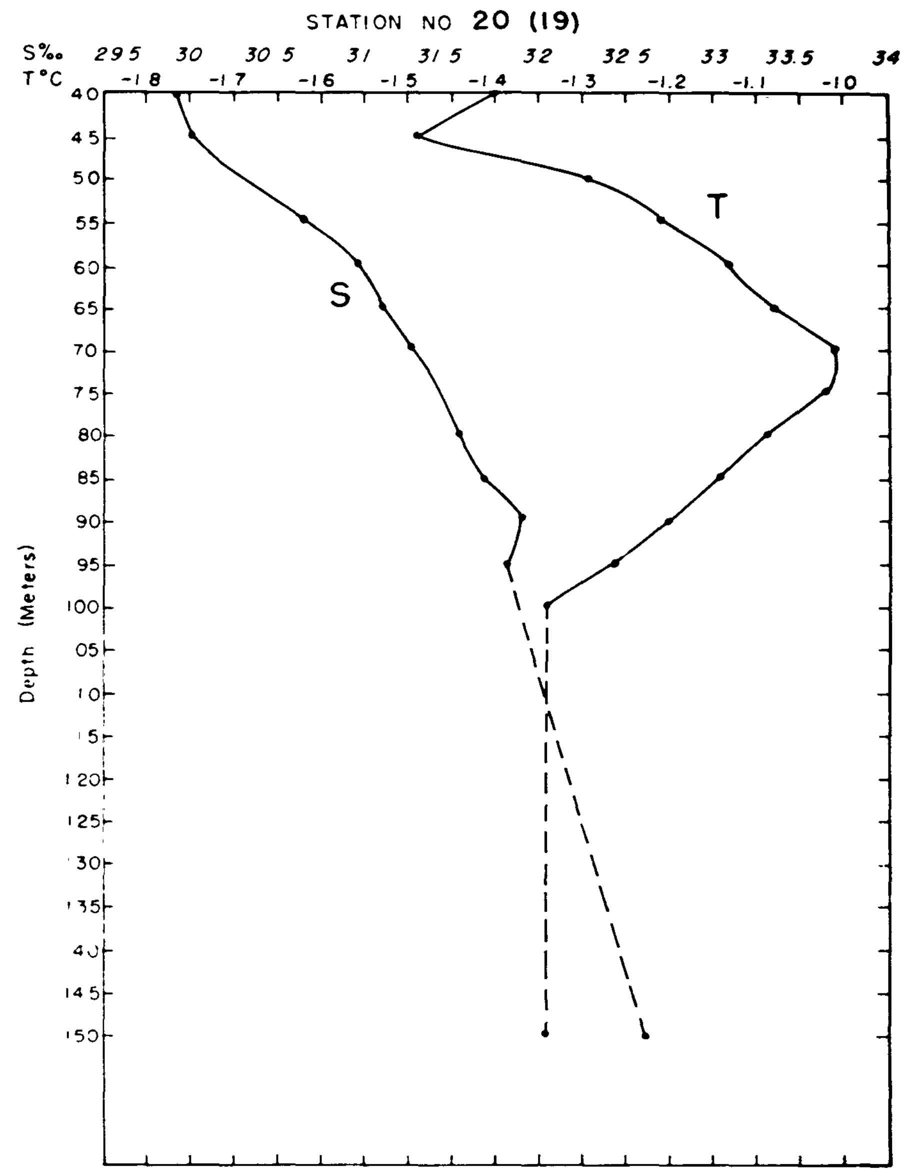
STATION NO 14 (13)

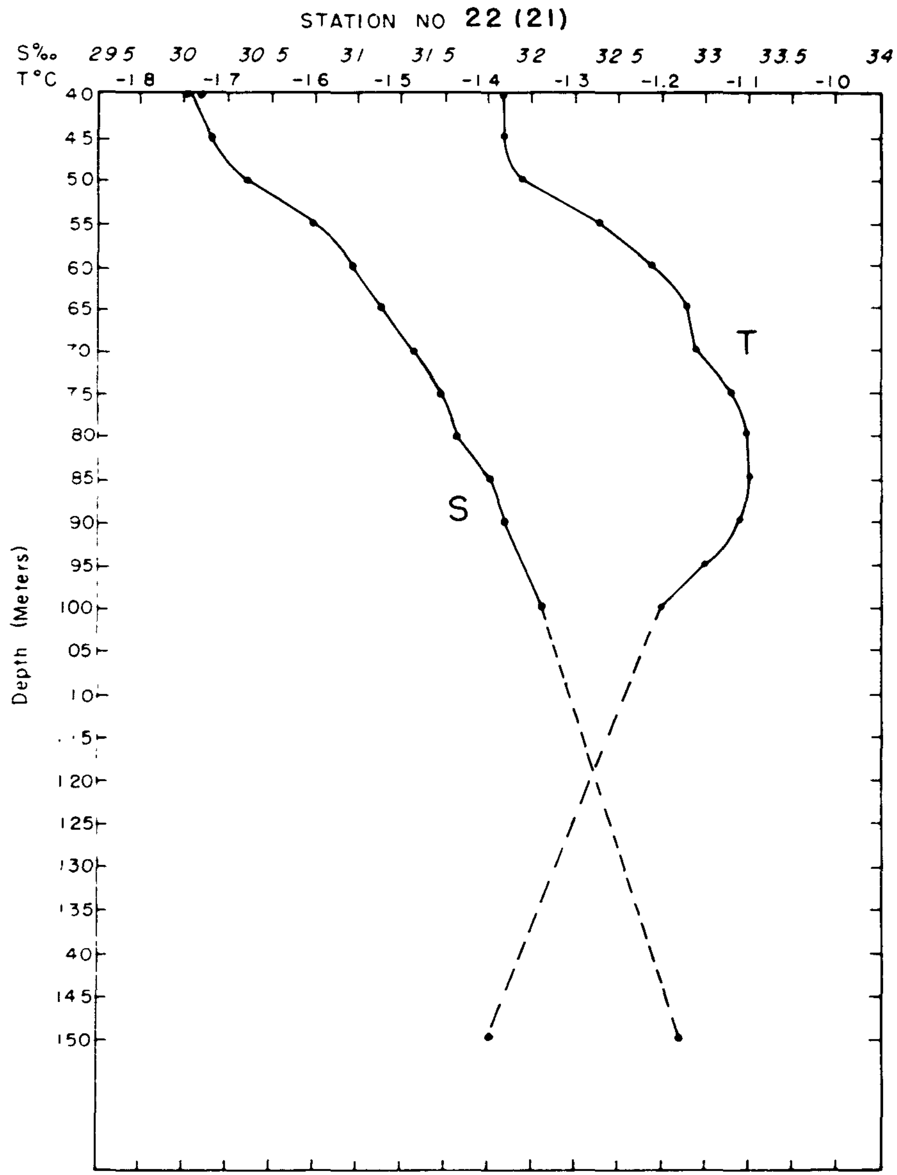


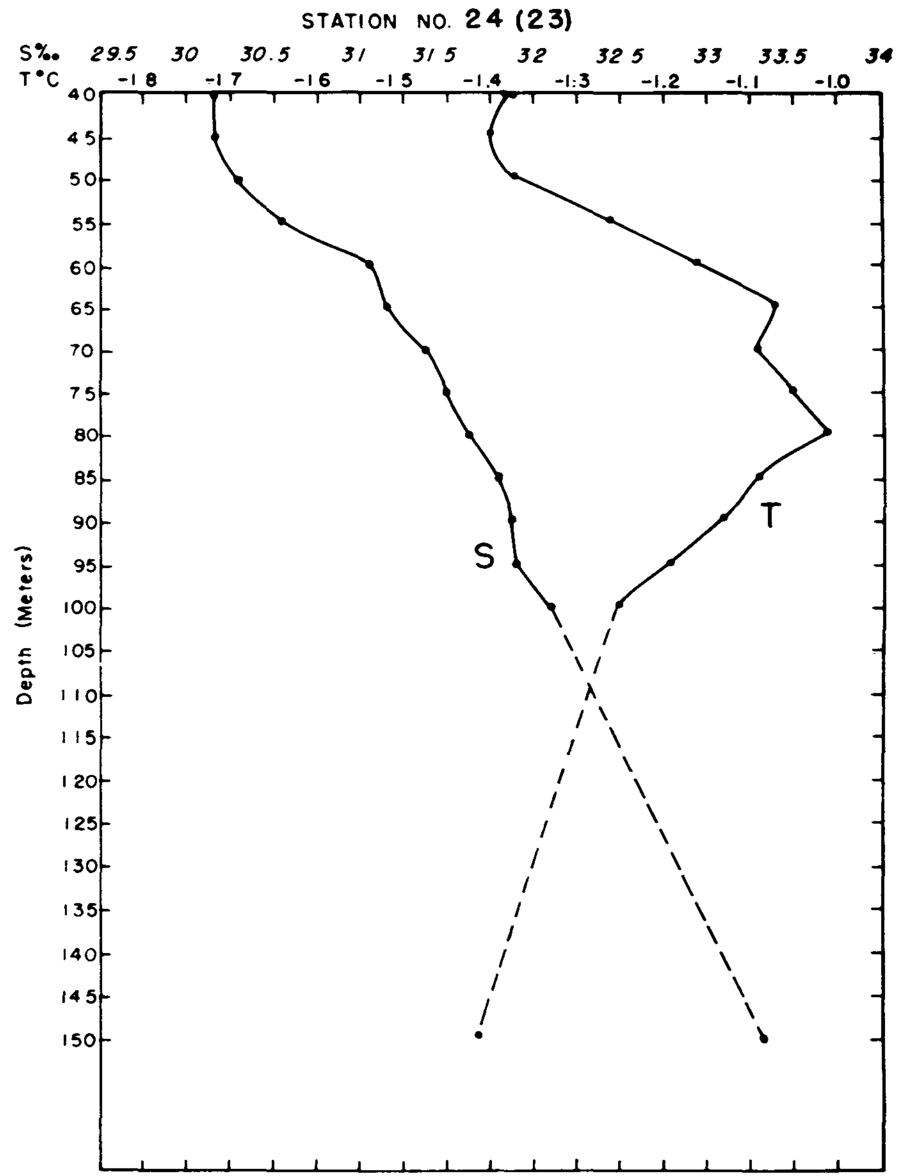
STATION NO 16 (15)



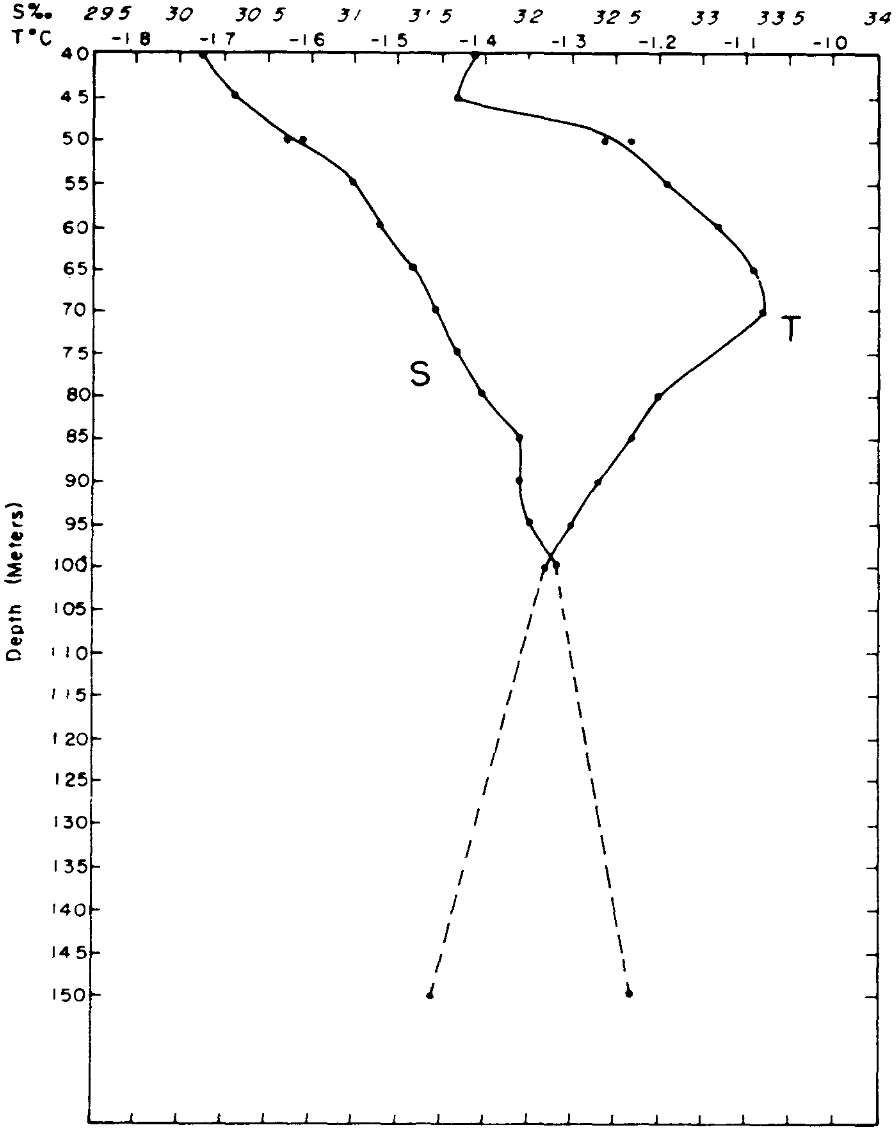

STATION NO 18 (17)
S‰
°C
Depth (Meters)
S
T
?


STATION NO 20 (19)
S‰
T°C
Depth (Meters)
S
T

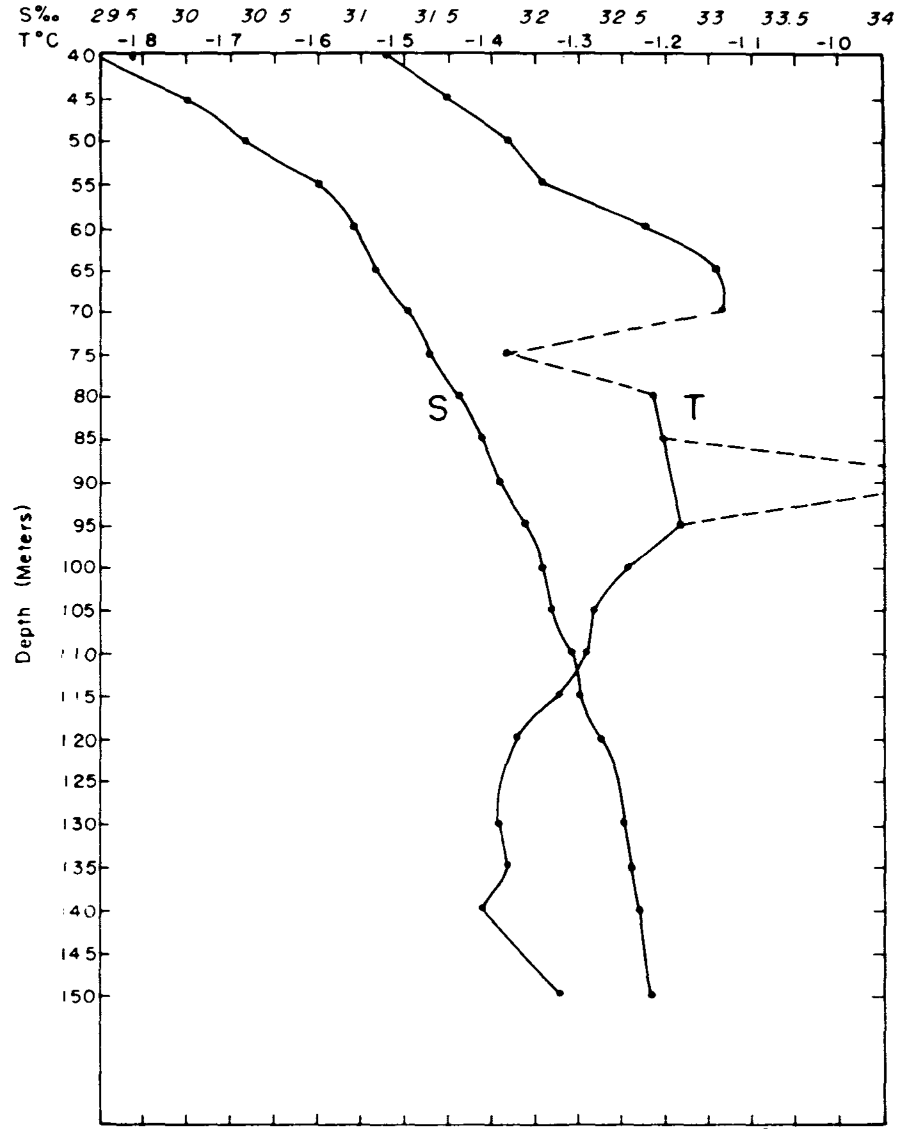

STATION NO 22 (21)
S‰
T°C
Depth (Meters)
S
T


STATION NO. 24 (23)
S‰
T°C
Depth (Meters)
S
T

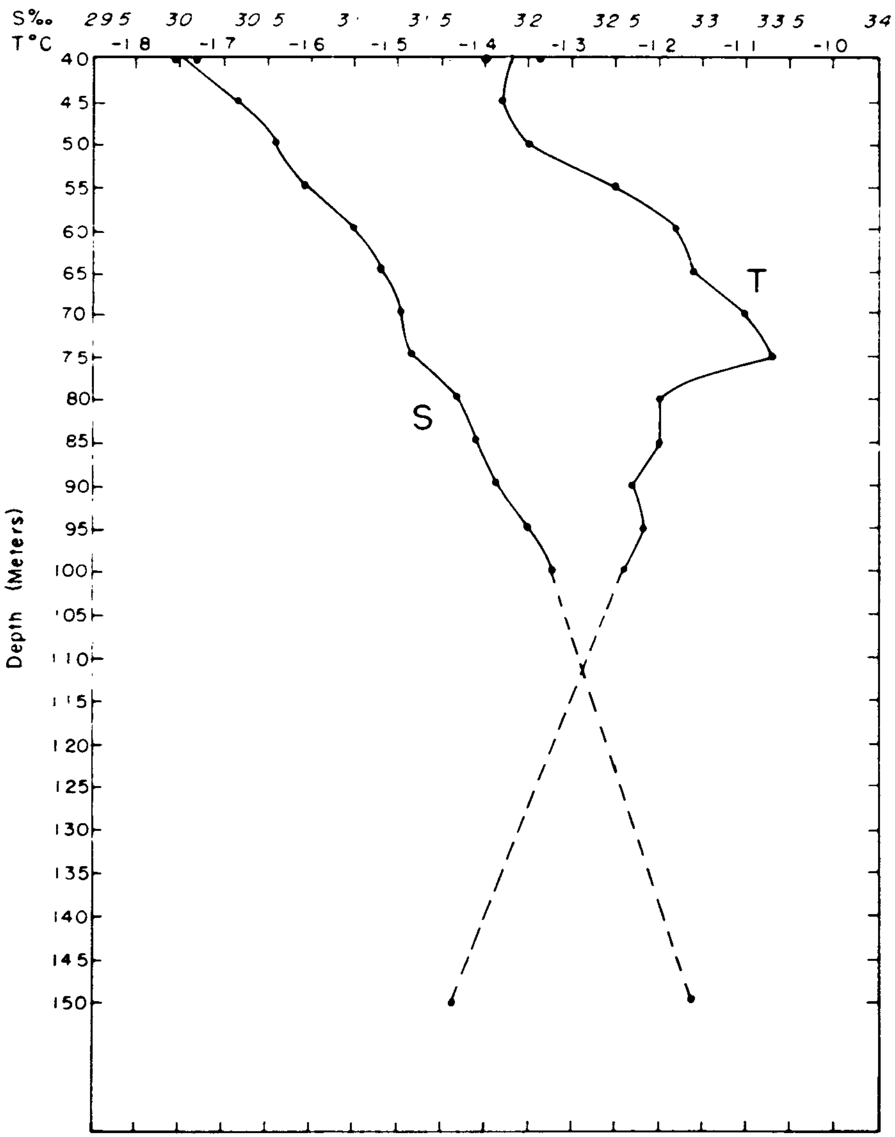
STATION NO **26 (25)**



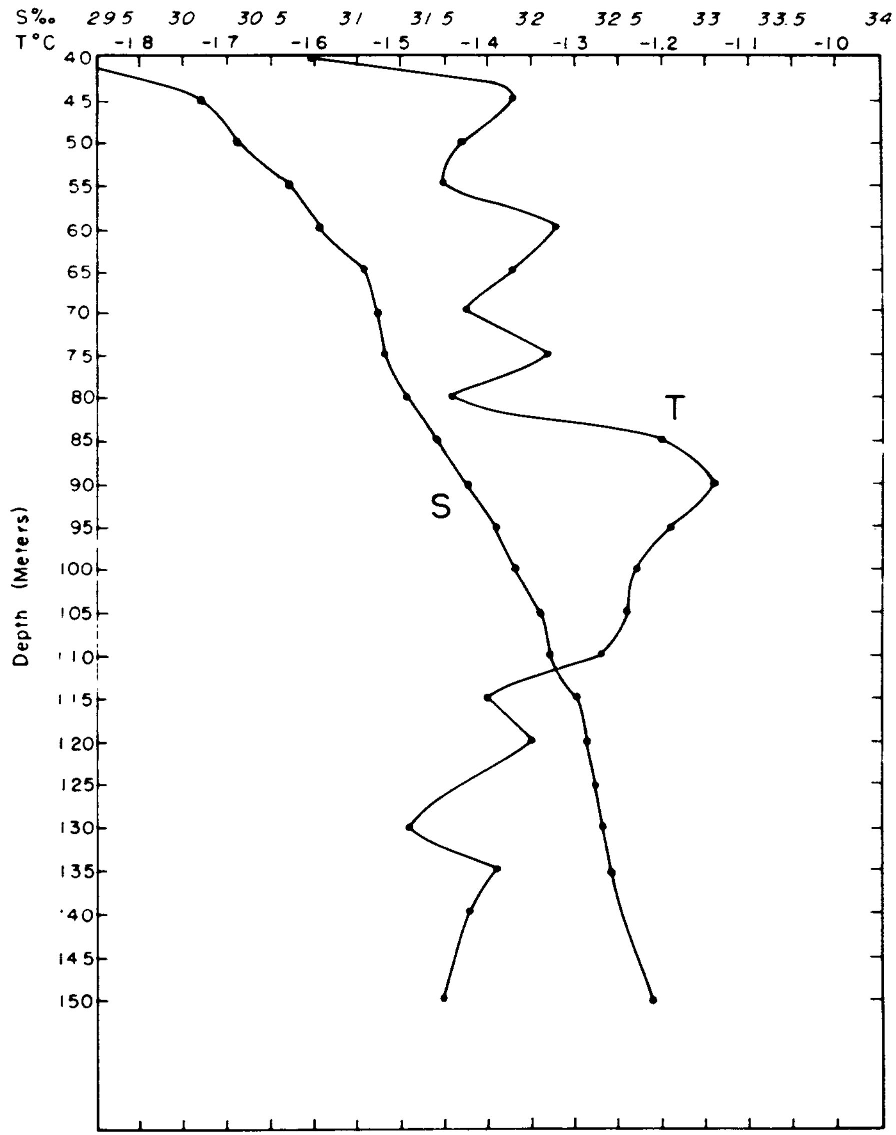
STATION NO **28 (27)**



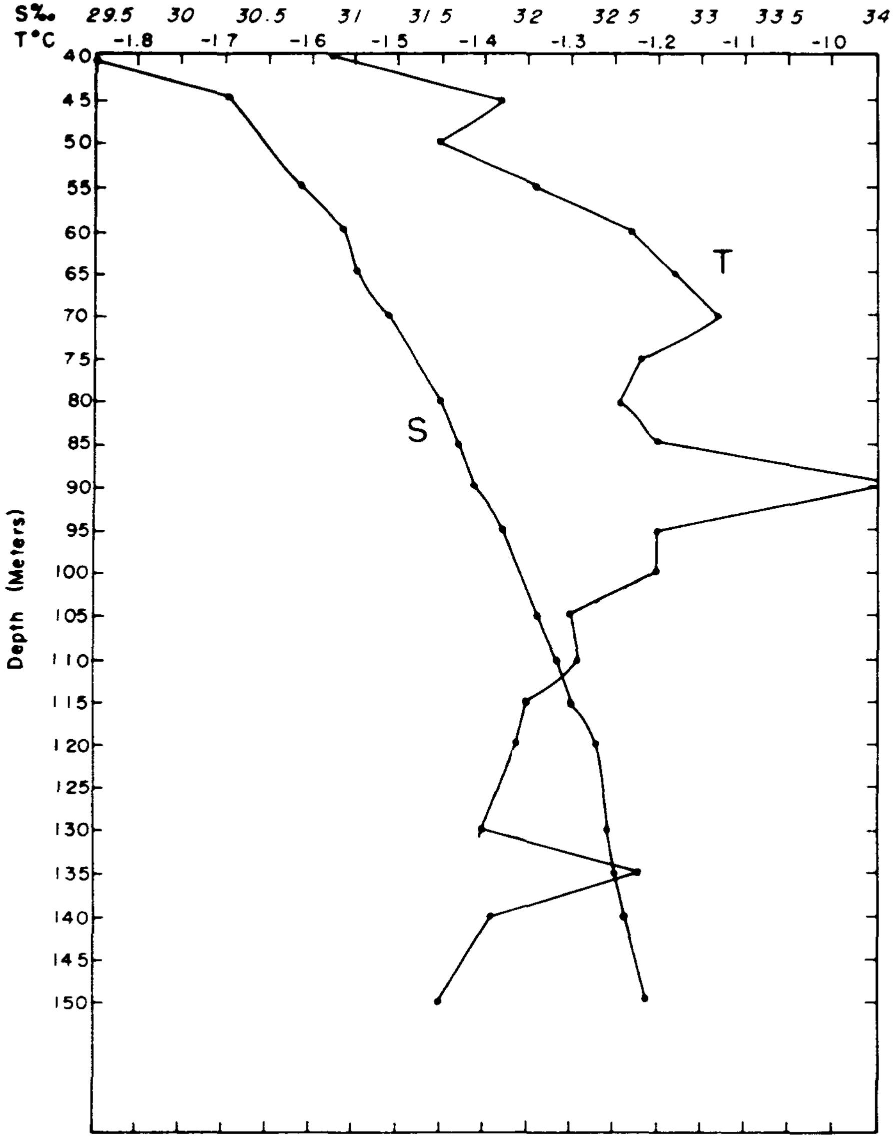
STATION NO 30 (29)



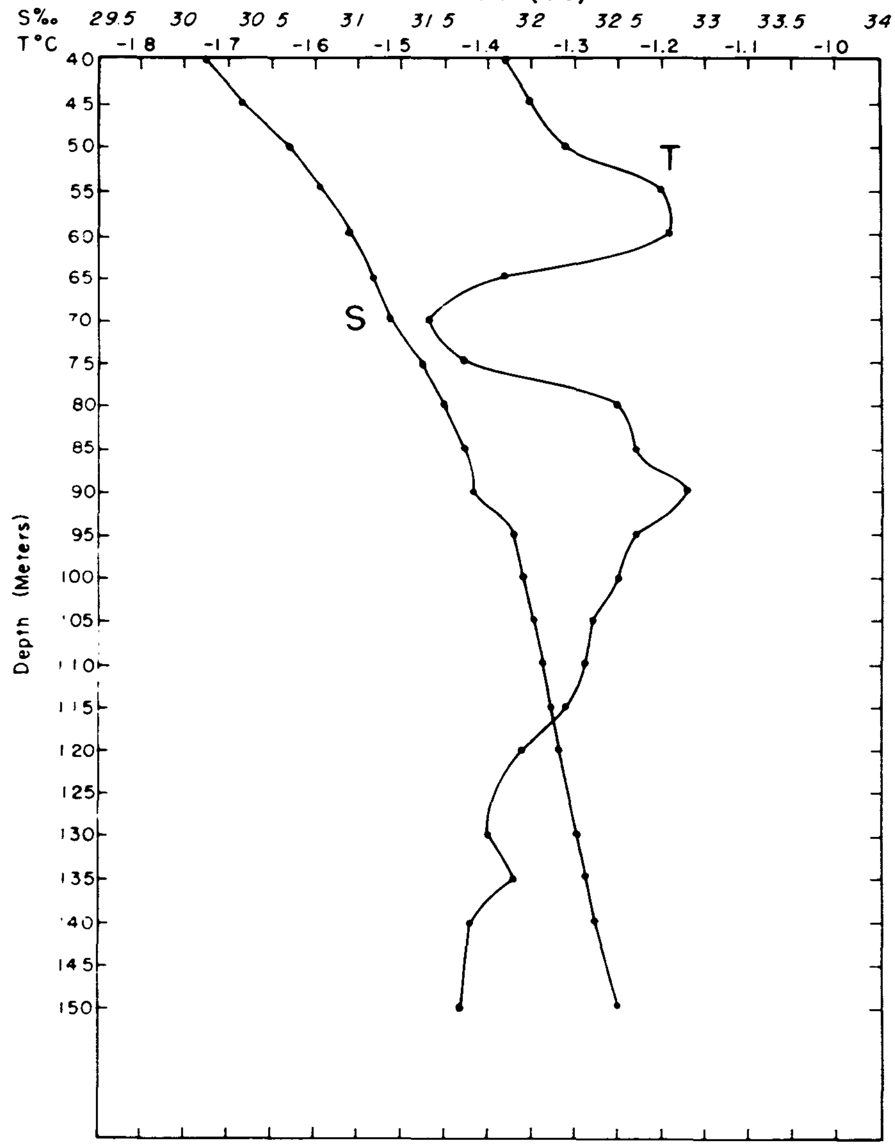
STATION NO 32 (31)



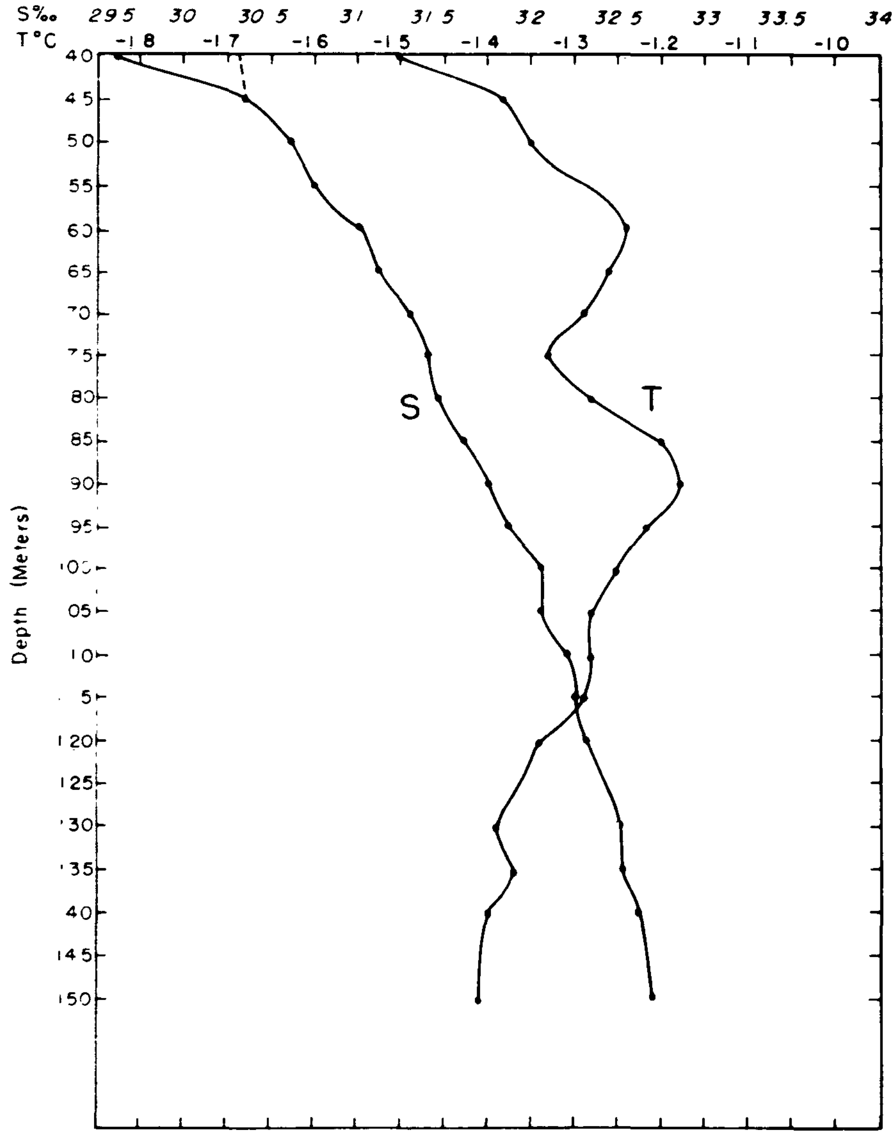
STATION NO 34 (33)



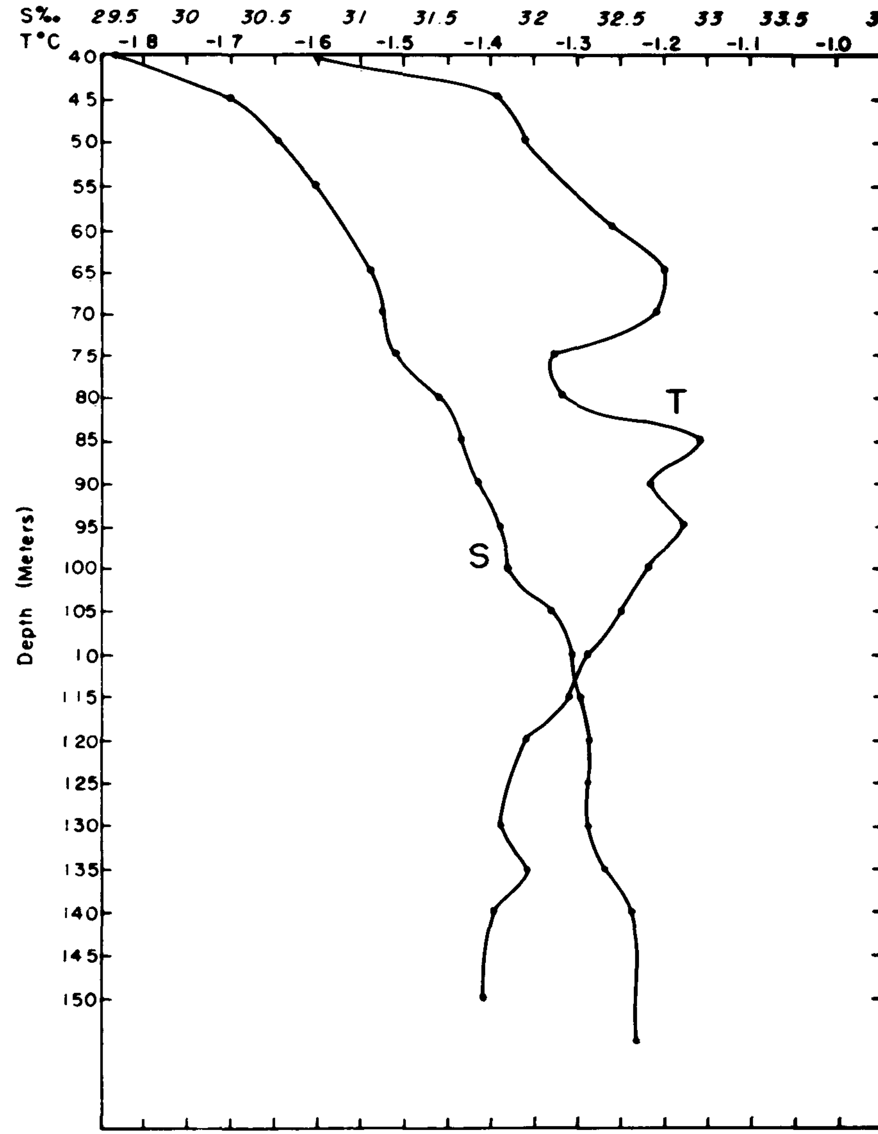
STATION NO. 36 (35)

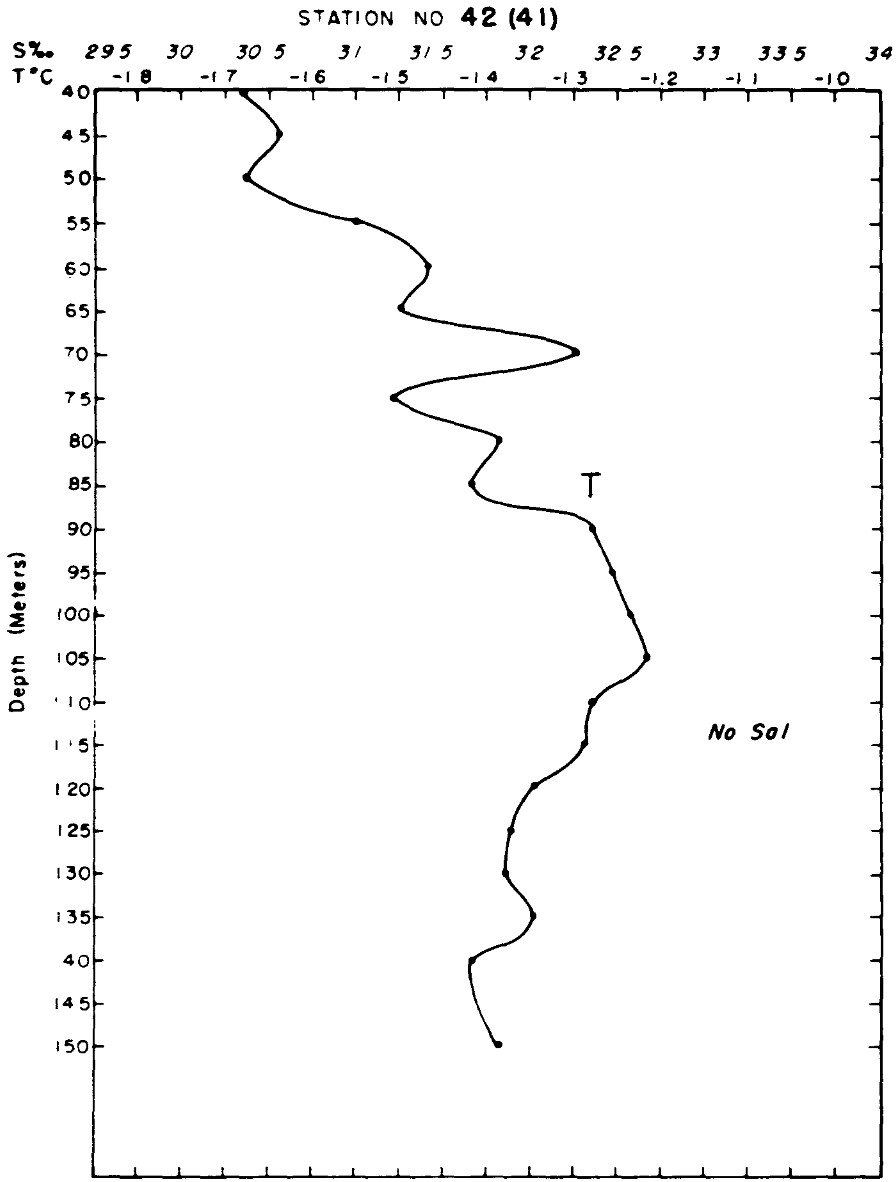


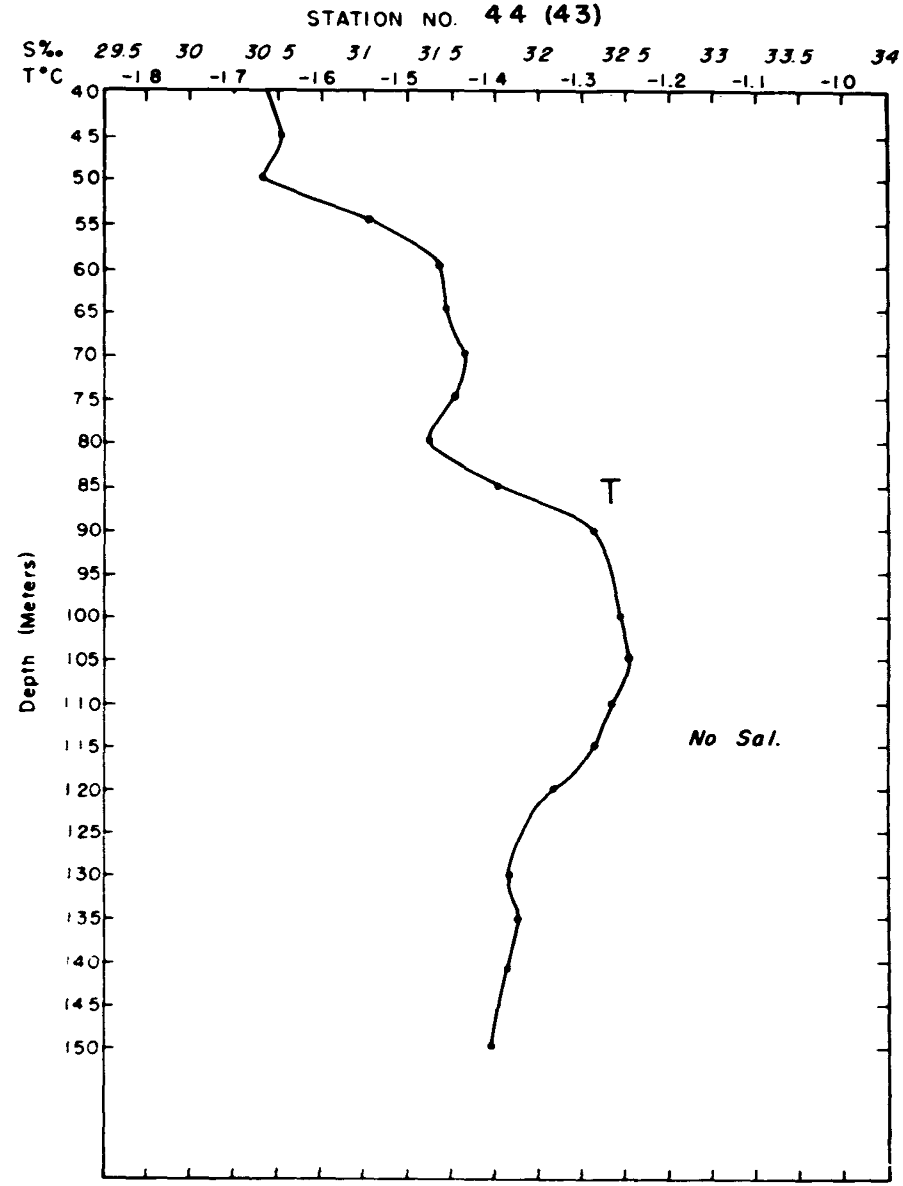
STATION NO 38 (37)

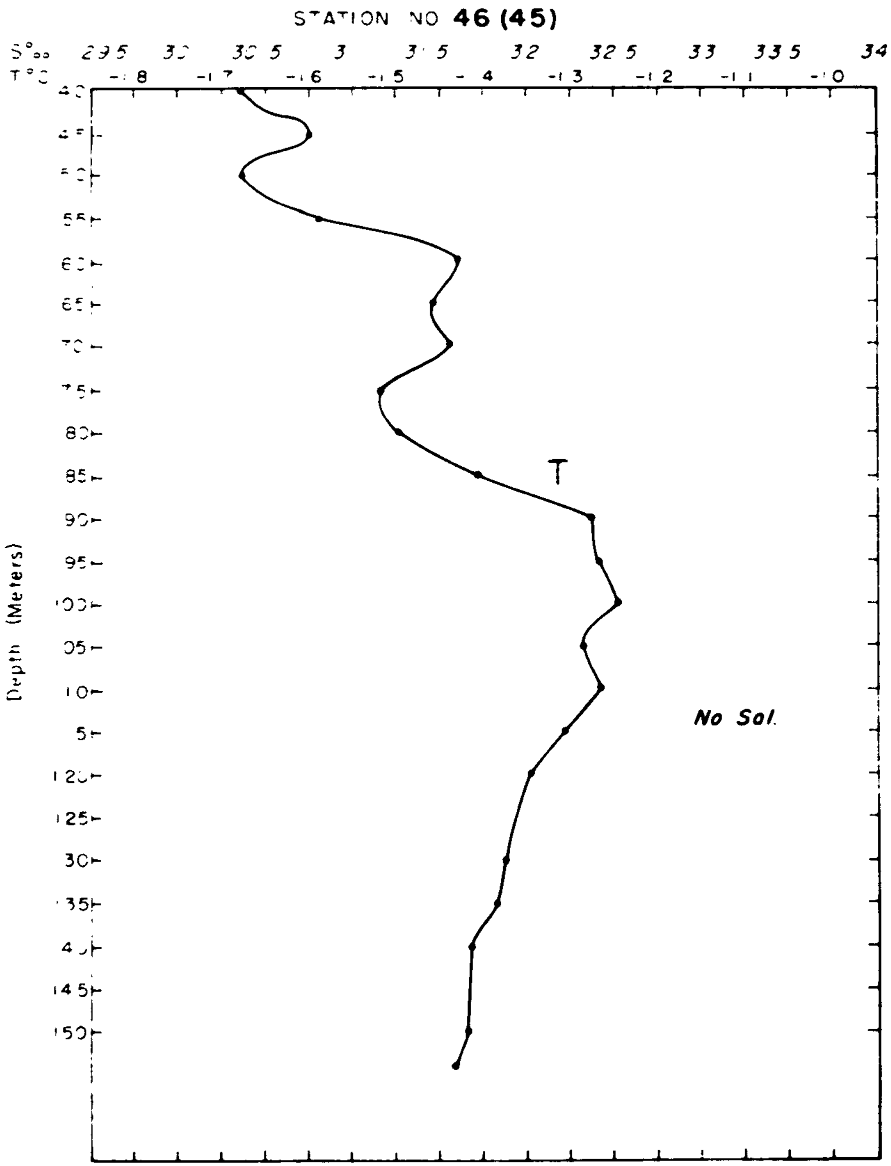


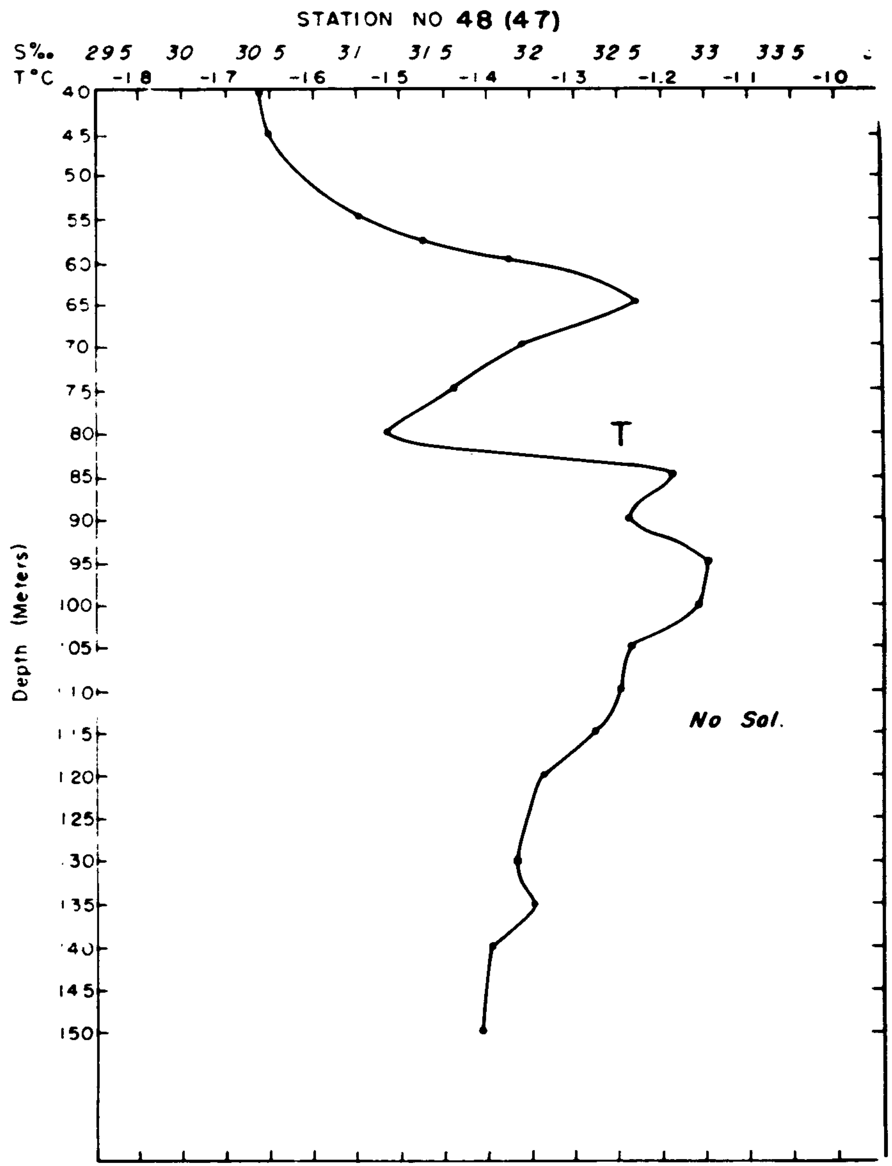
STATION NO. 40 (39)

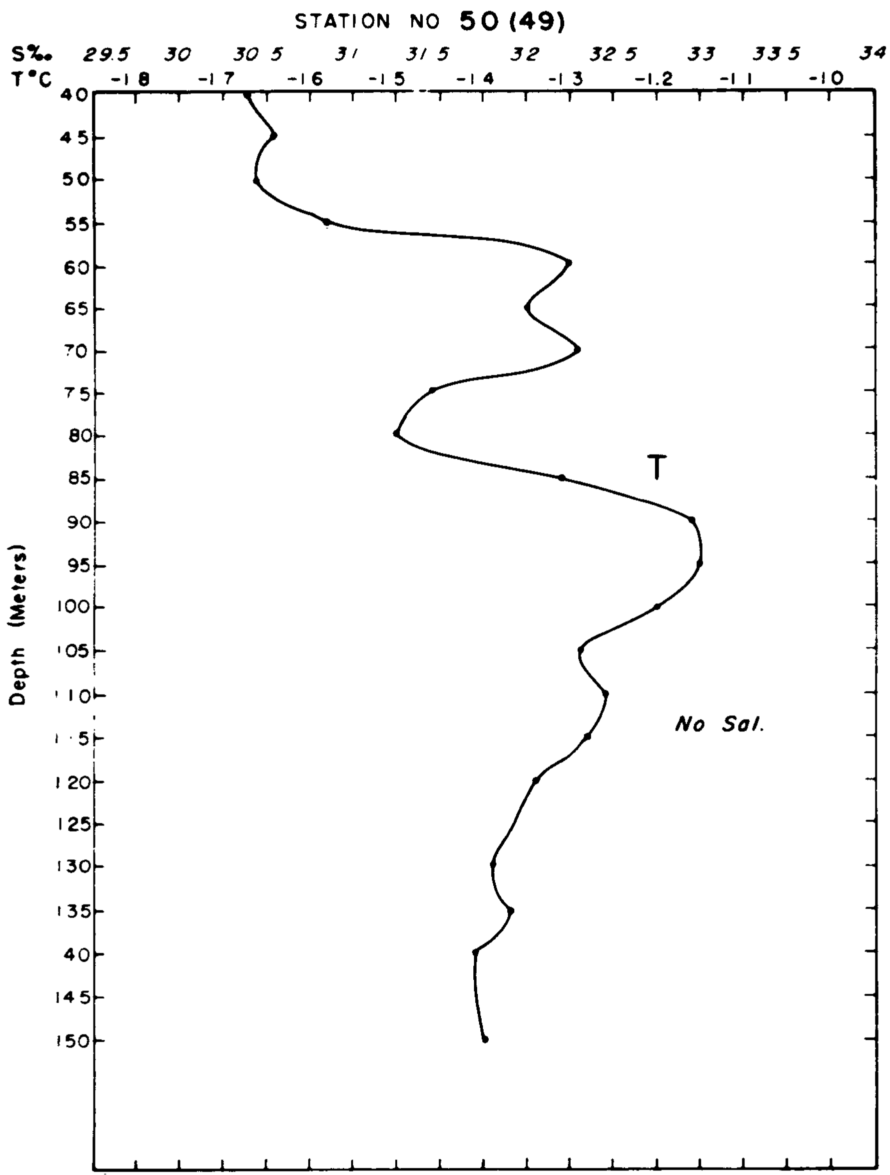


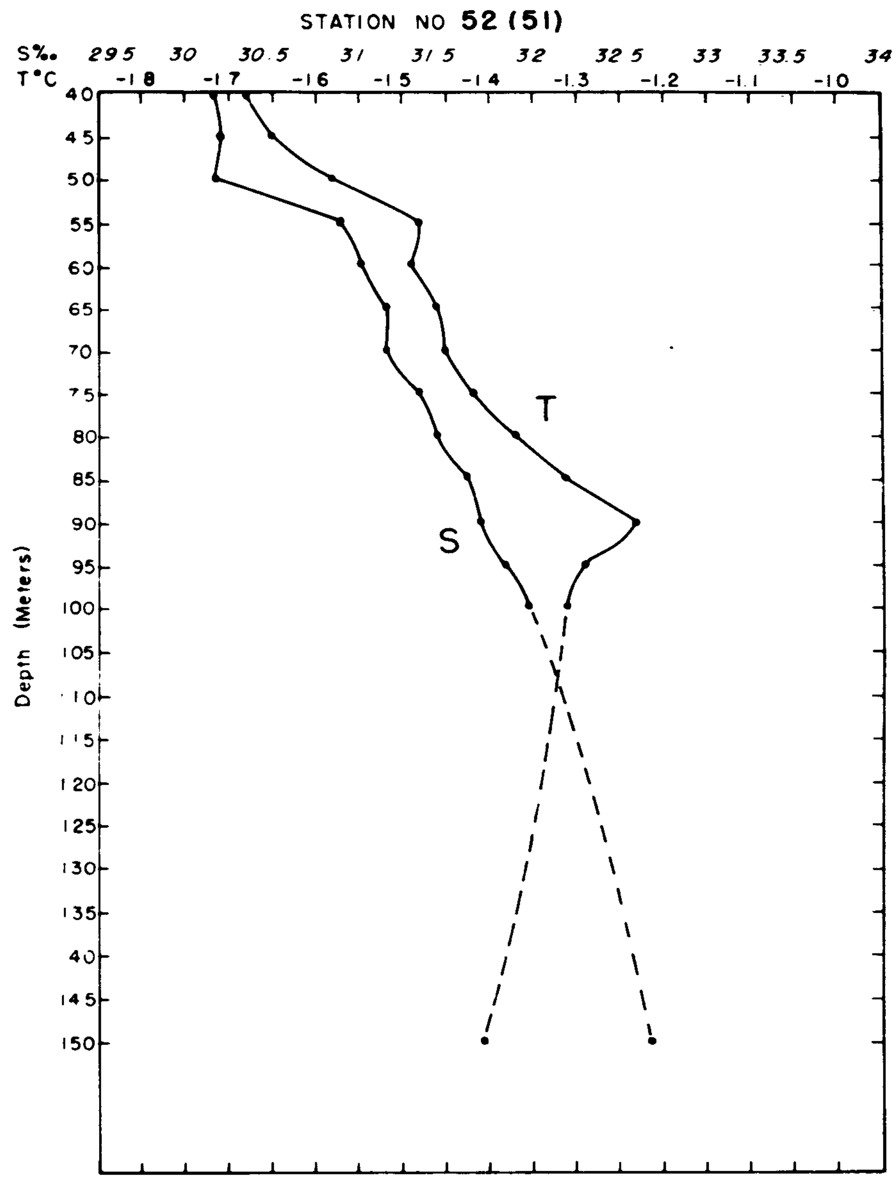

STATION NO 42 (41)
S‰
T°C
29.5 30 30.5 31 31.5 32 32.5 33 33.5 34
-1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1 -1.0
40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150
Depth (Meters)
T
No Sal

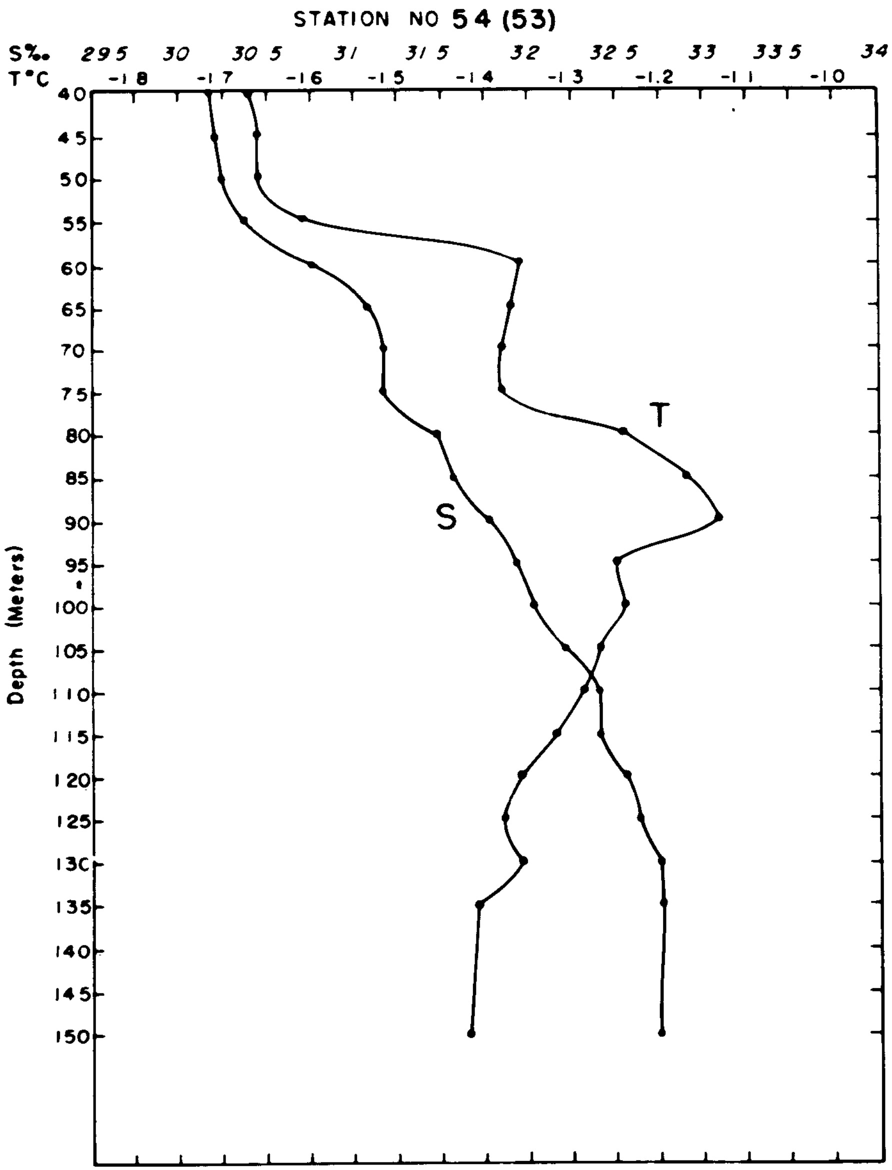

STATION NO. 44 (43)
S‰
T°C
29.5 30 30.5 31 31.5 32 32.5 33 33.5 34
-1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1 -1.0
40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150
Depth (Meters)
T
No Sal.

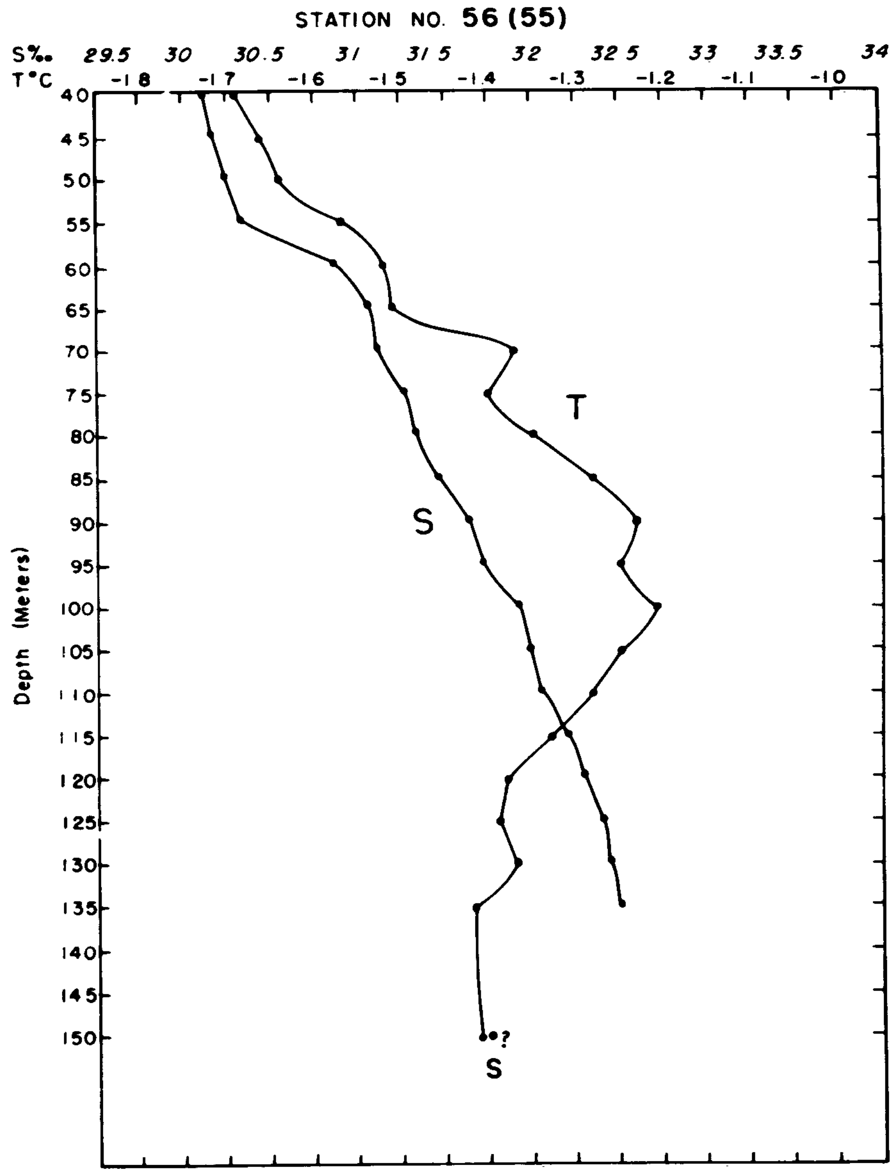

STATION NO 46 (45)
S‰
T°C
Depth (Meters)
T
No Sol.


STATION NO 48 (47)
S‰
T°C
Depth (Meters)
T
No Sol.

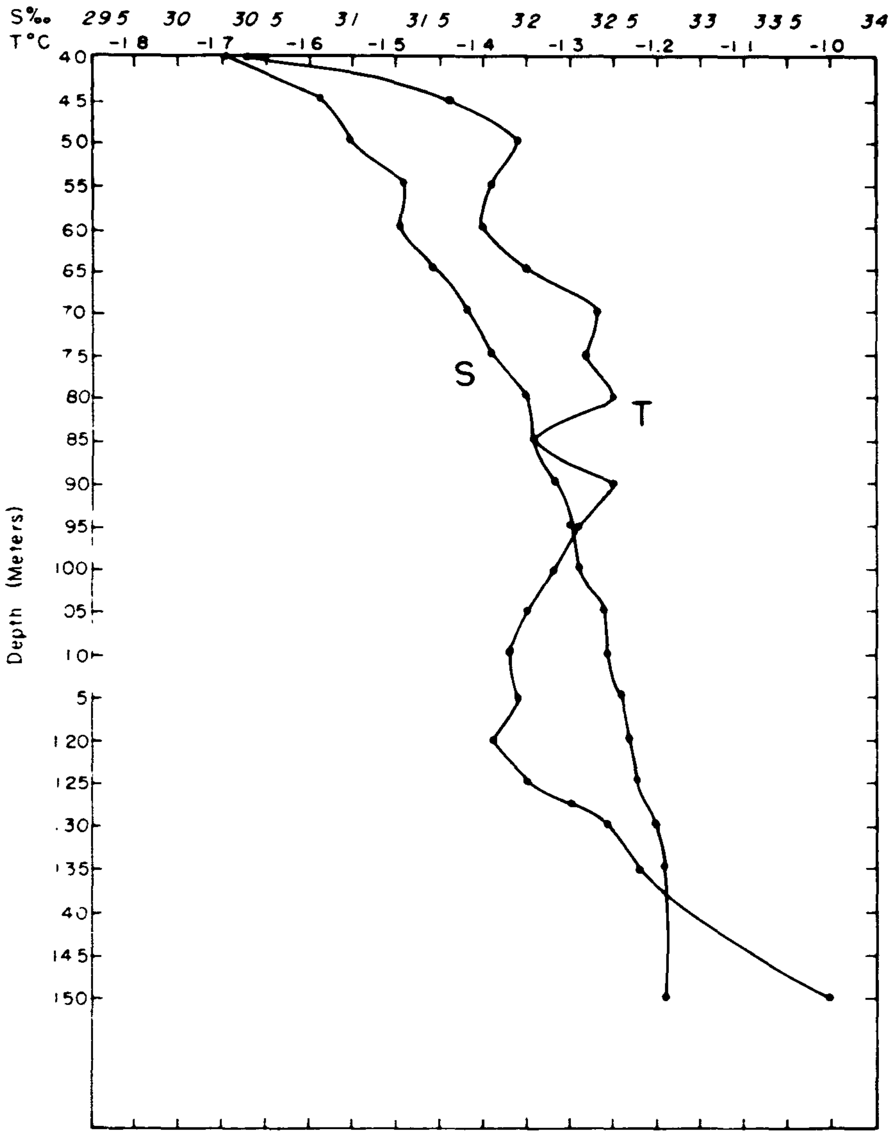

STATION NO 50 (49)
S‰
T°C
Depth (Meters)
T
No Sal.


STATION NO 52 (51)
S‰
T°C
Depth (Meters)
T
S

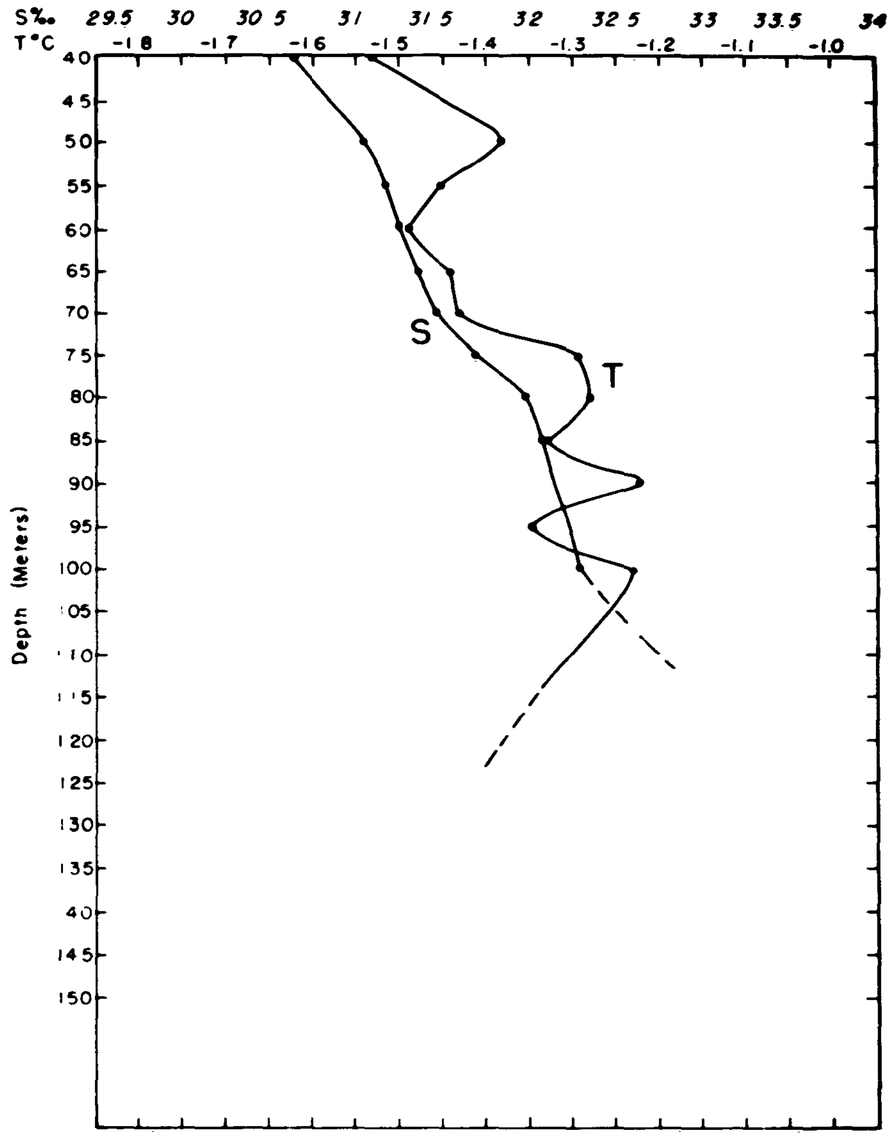

STATION NO 54 (53)
S‰
T°C
Depth (Meters)
T
S


STATION NO. 56 (55)
S‰
T°C
Depth (Meters)
T
S
?

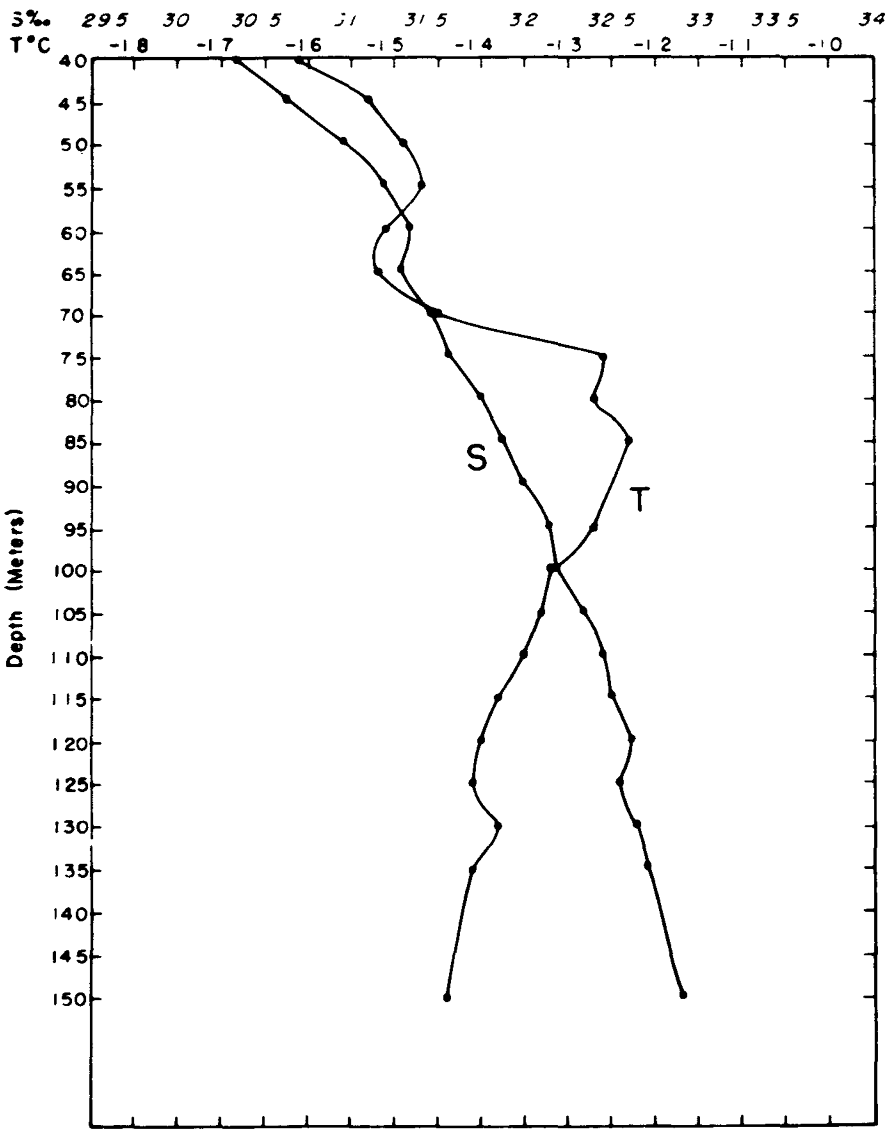
STATION NO 58 (57)



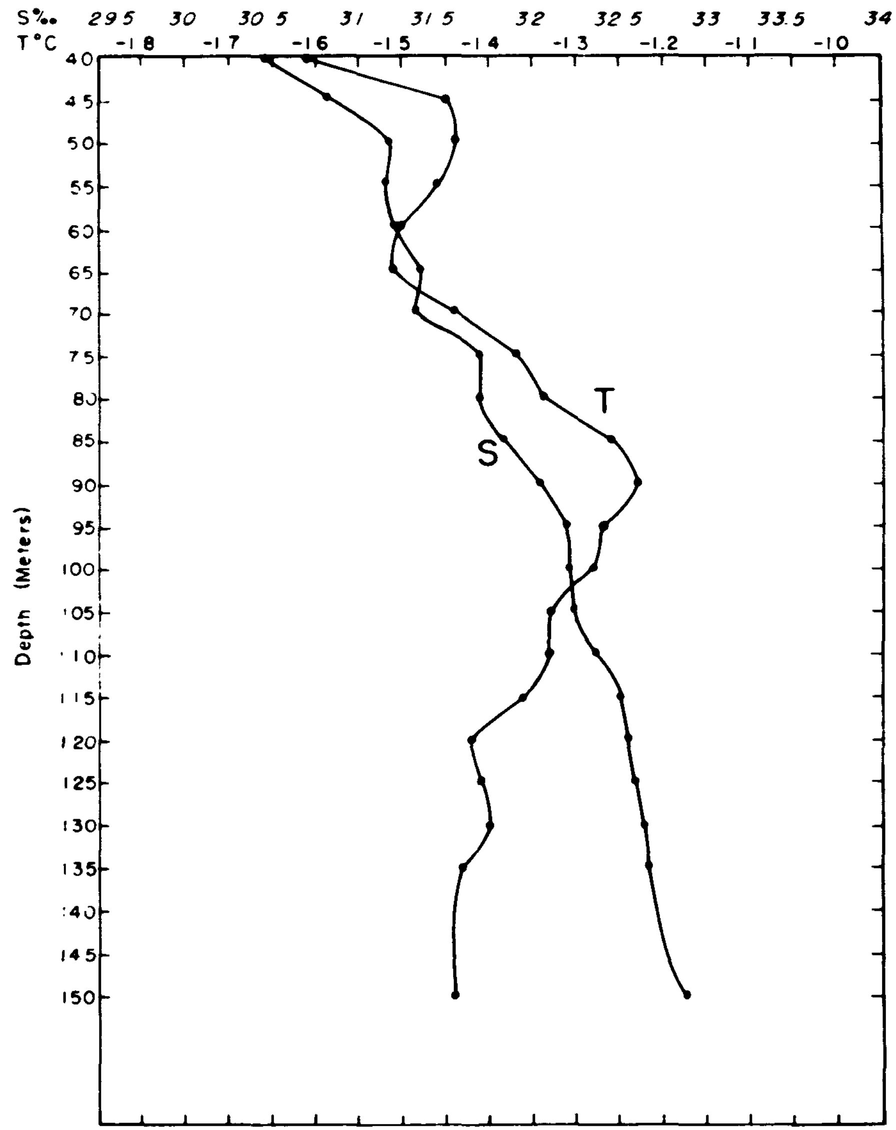
STATION NO 60 (59)



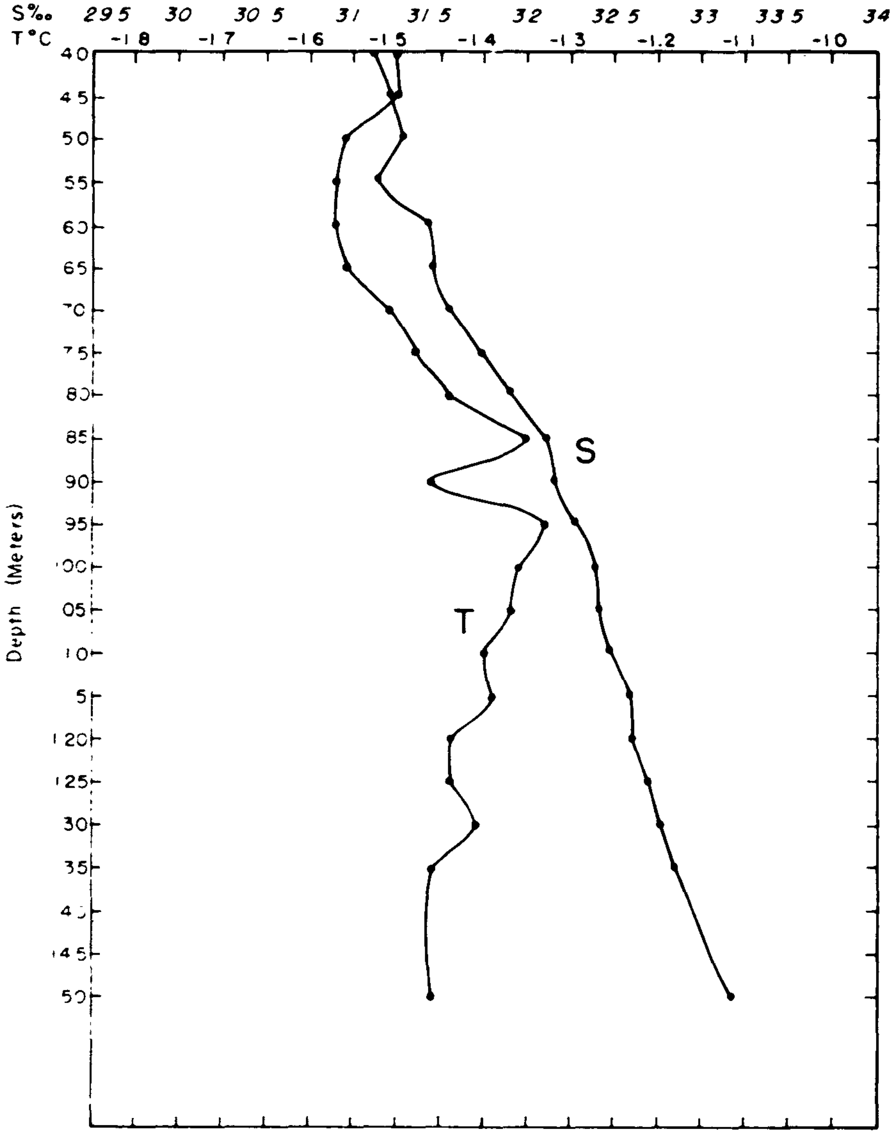
STATION NO 63 (62)



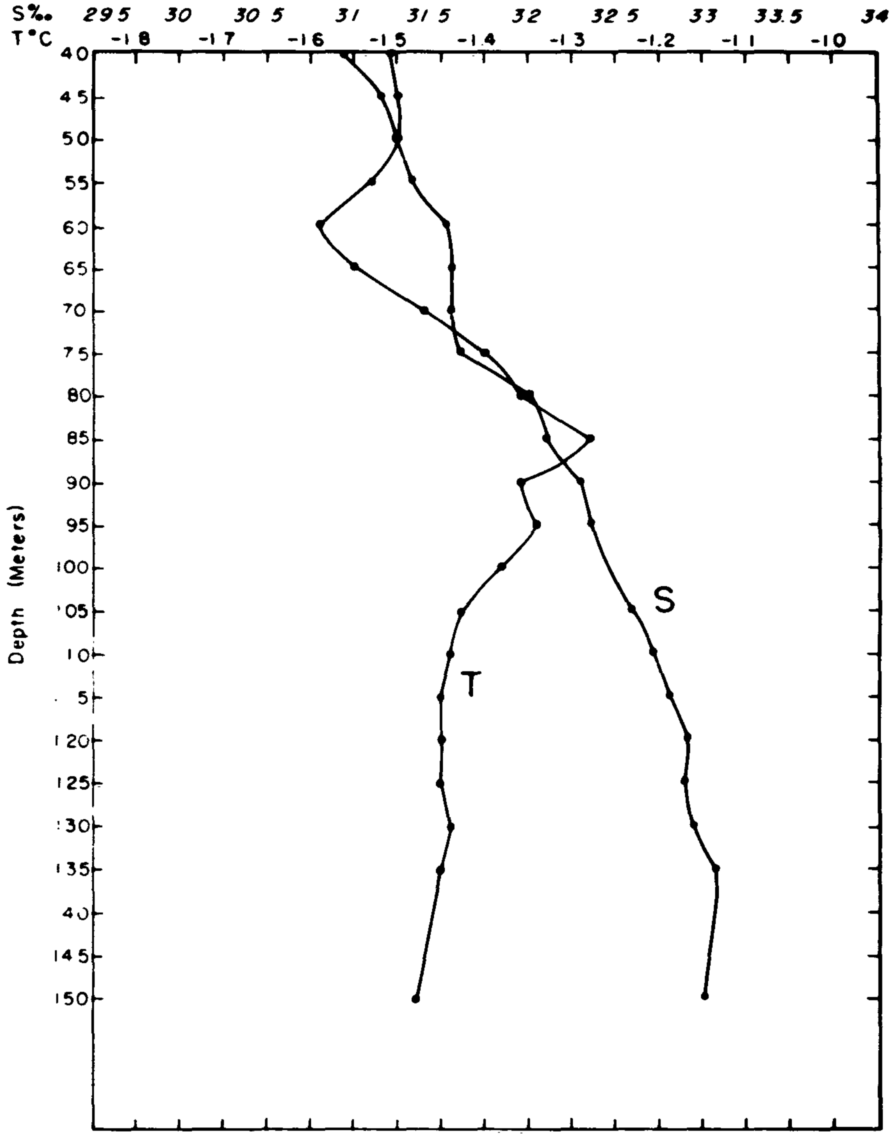
STATION NO 65 (64)



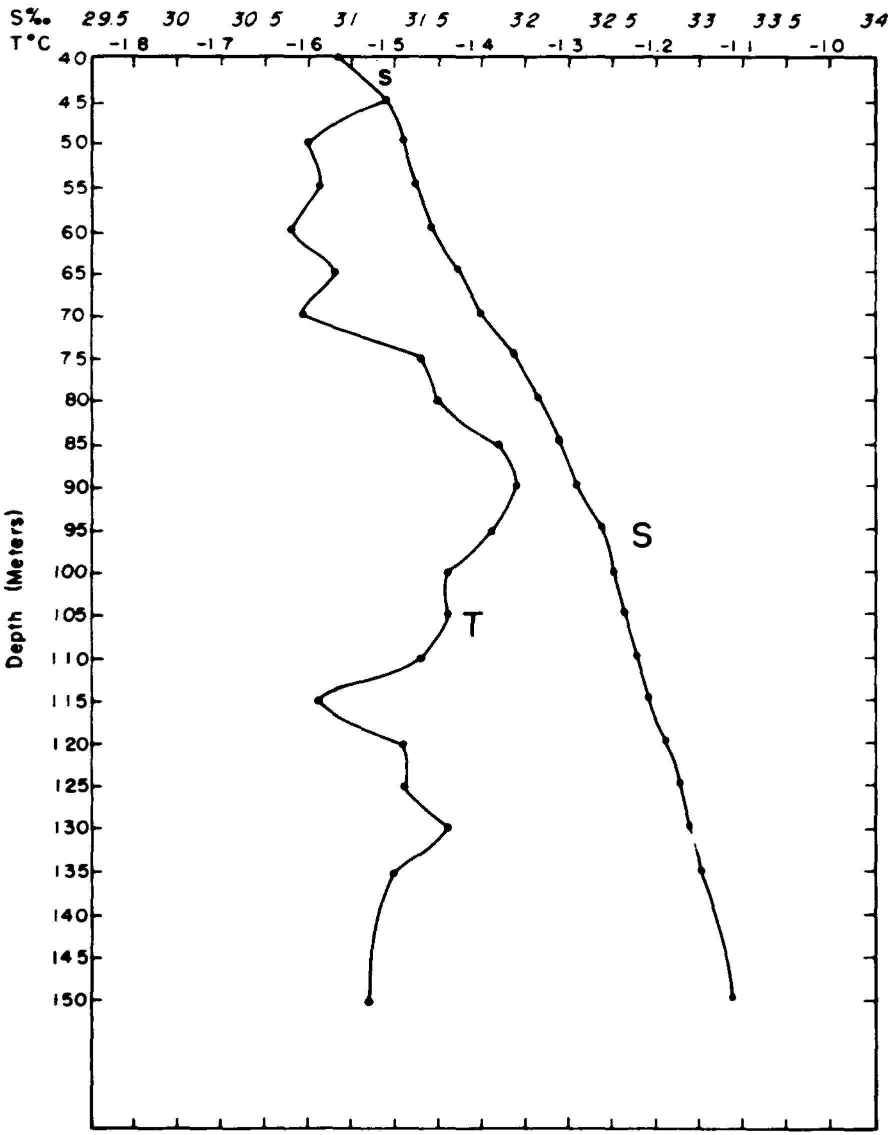
STATION NO 70 (69)



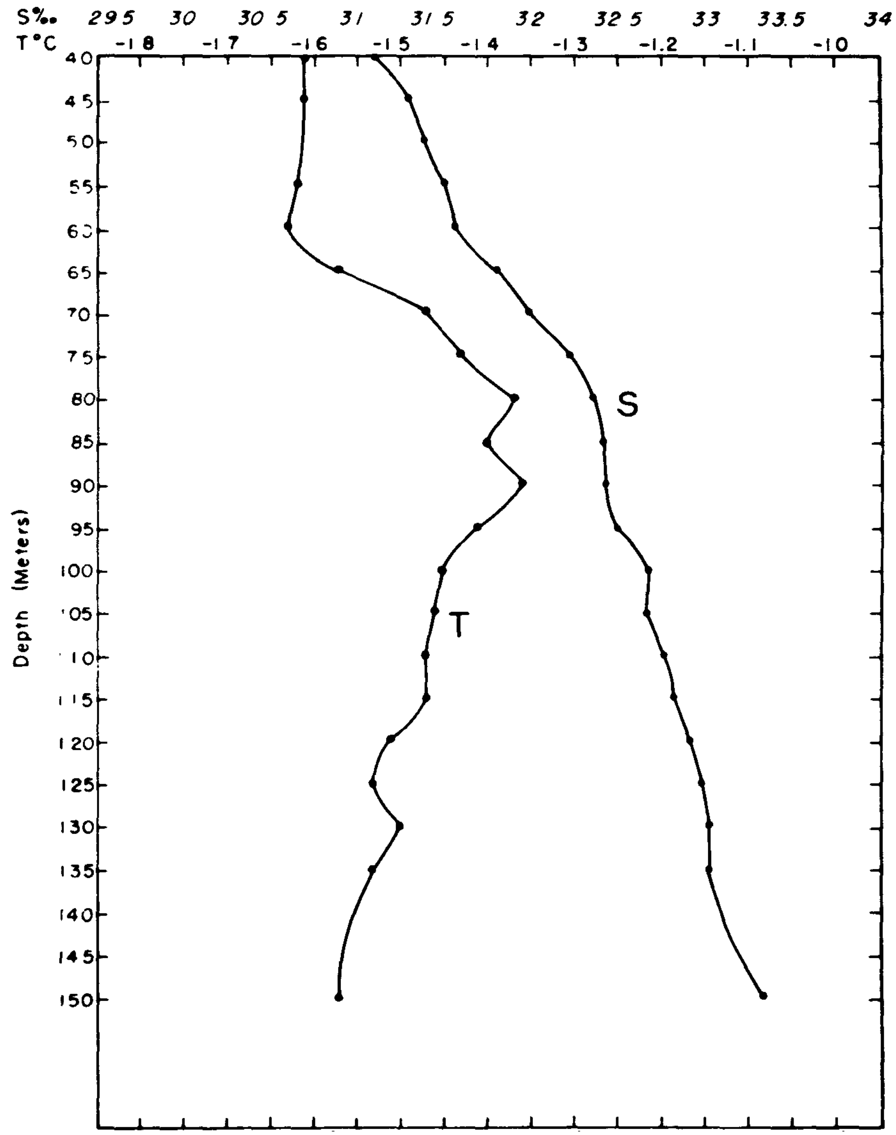
STATION NO 72 (71)



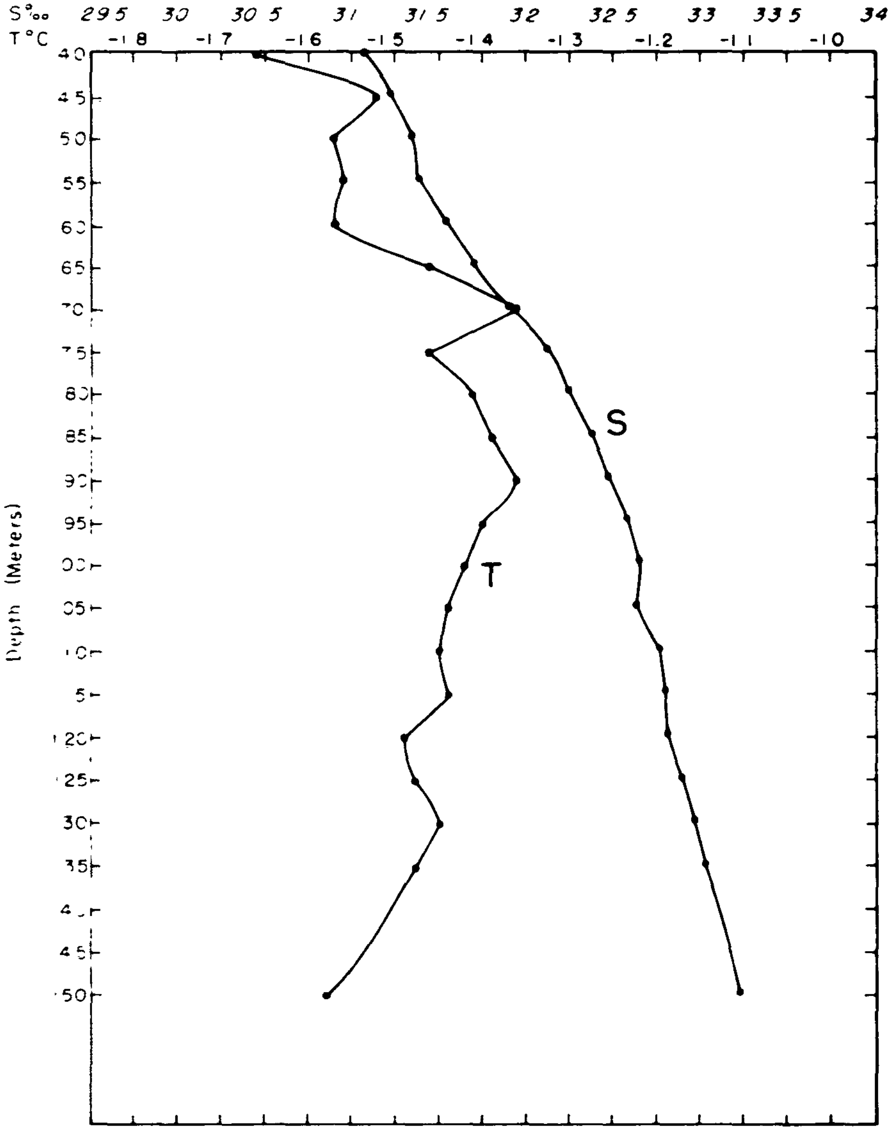
STATION NO 74 (73)



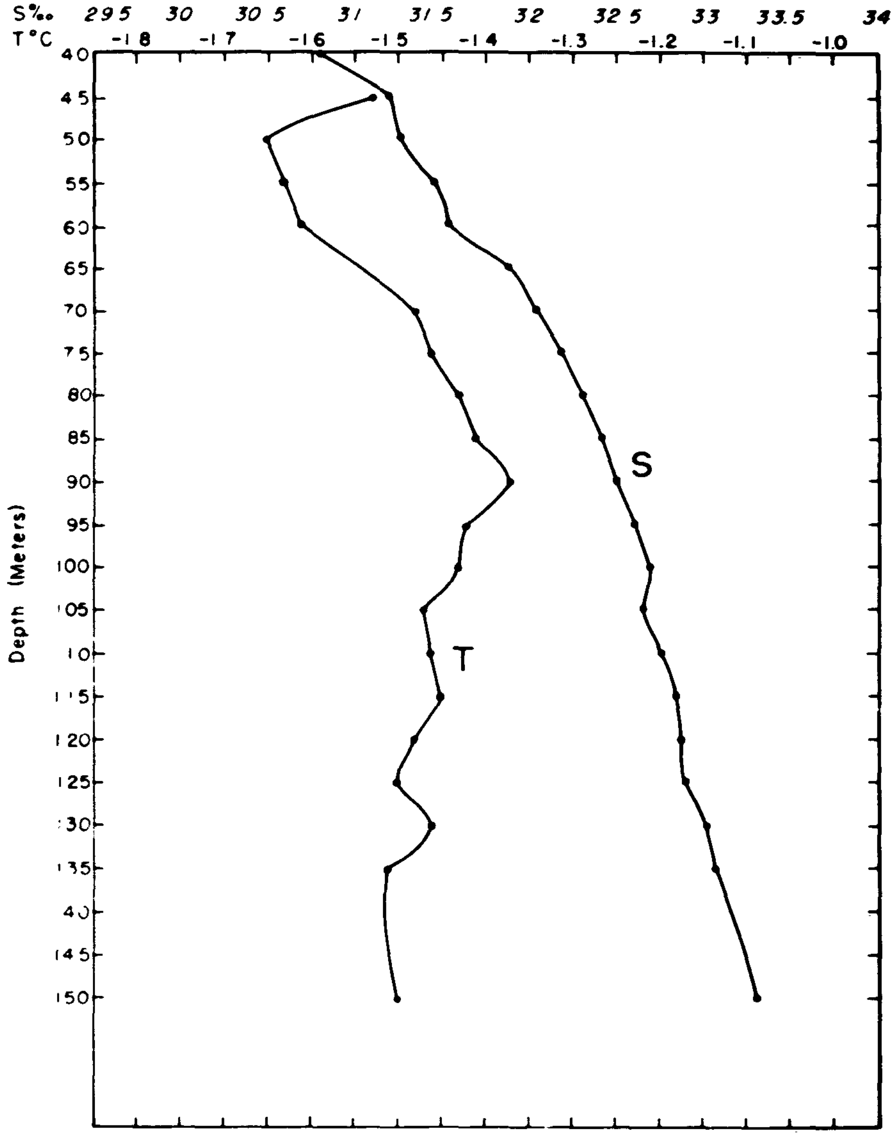
STATION NO 76 (75)



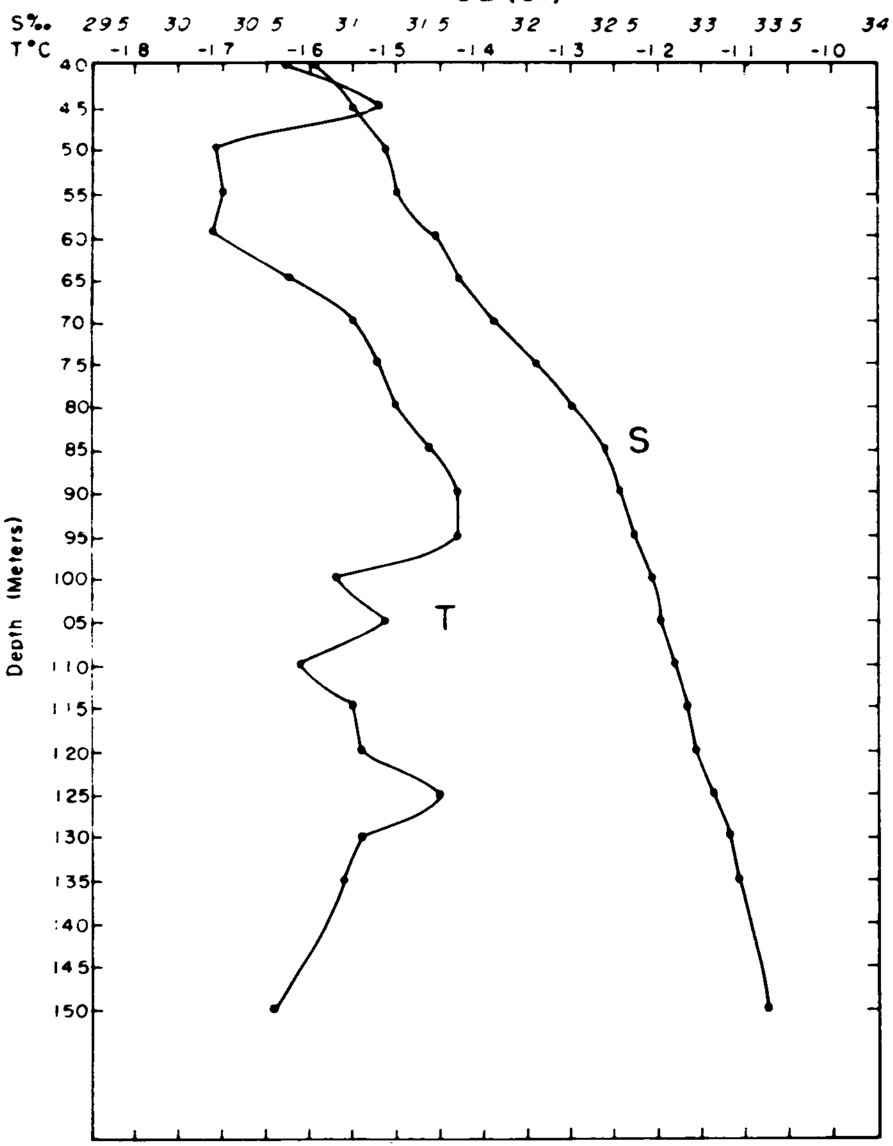
STATION NO 78 (77)



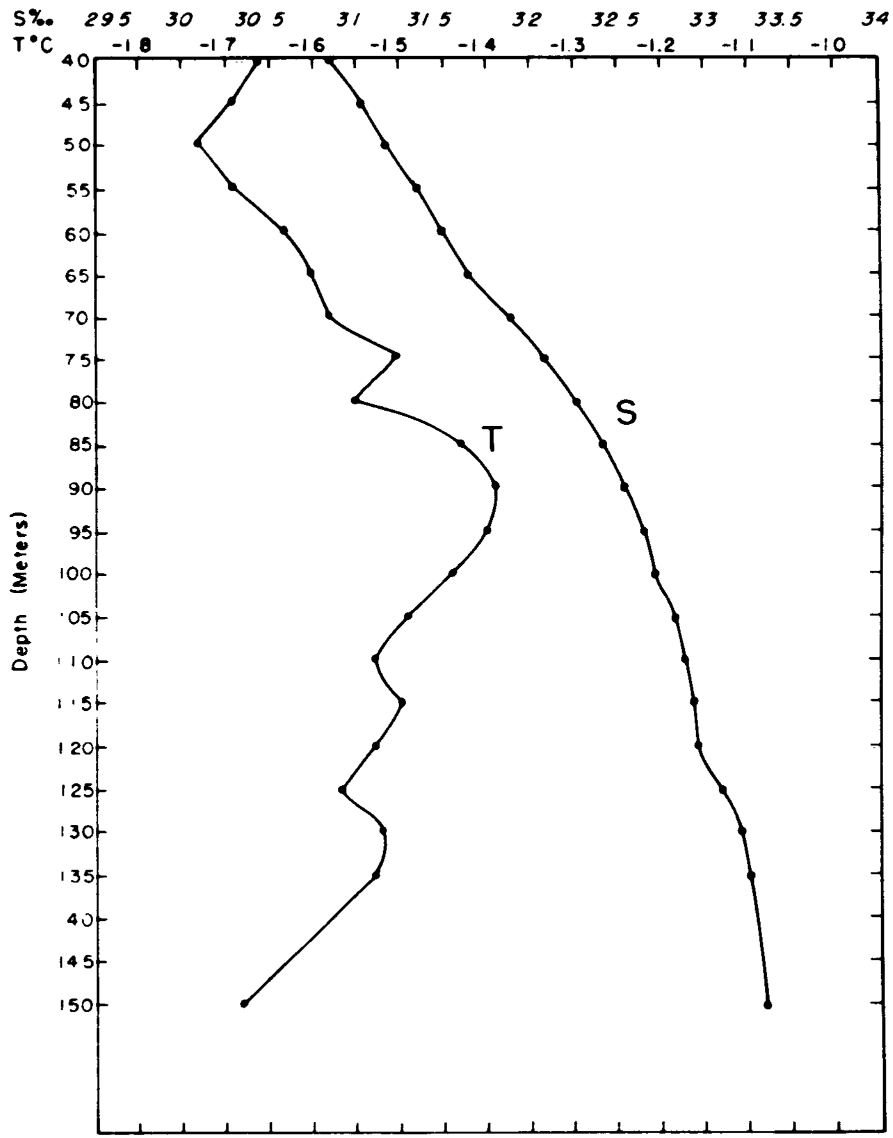
STATION NO 80 (79)



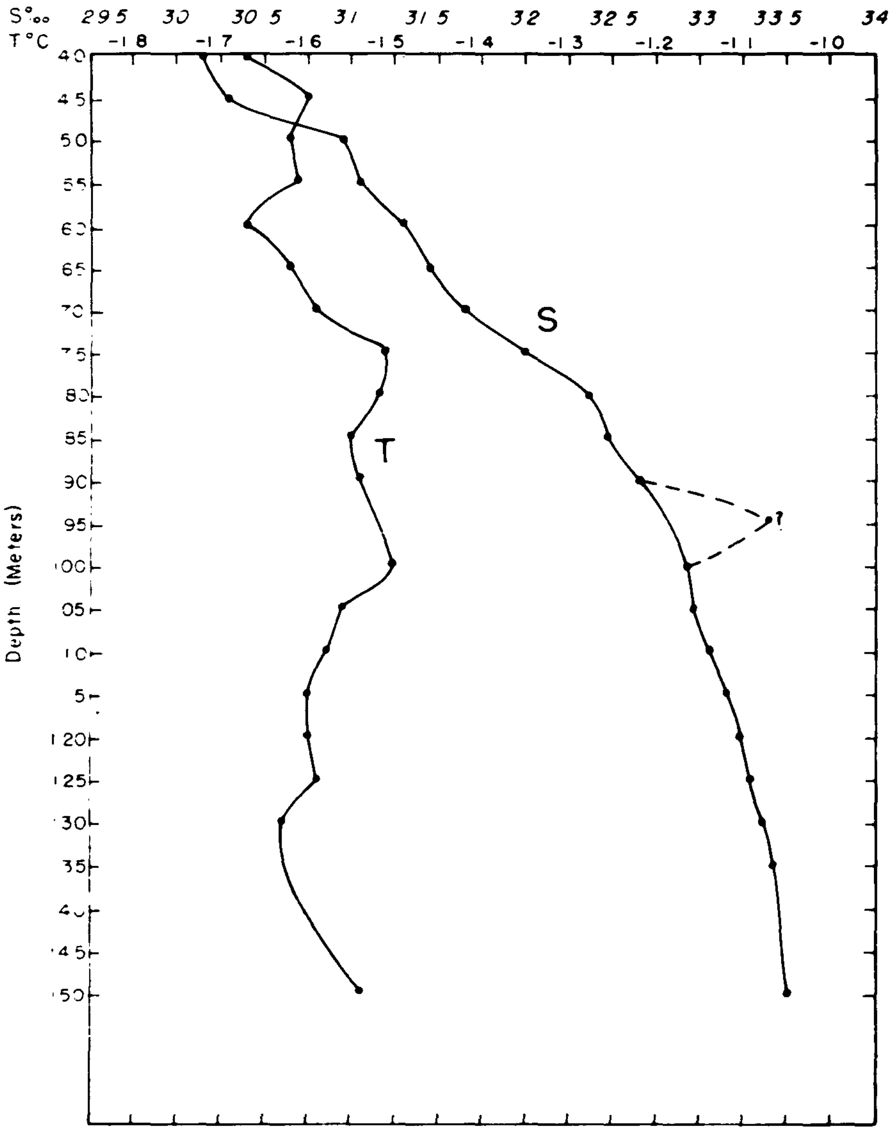
STATION NO 82 (81)



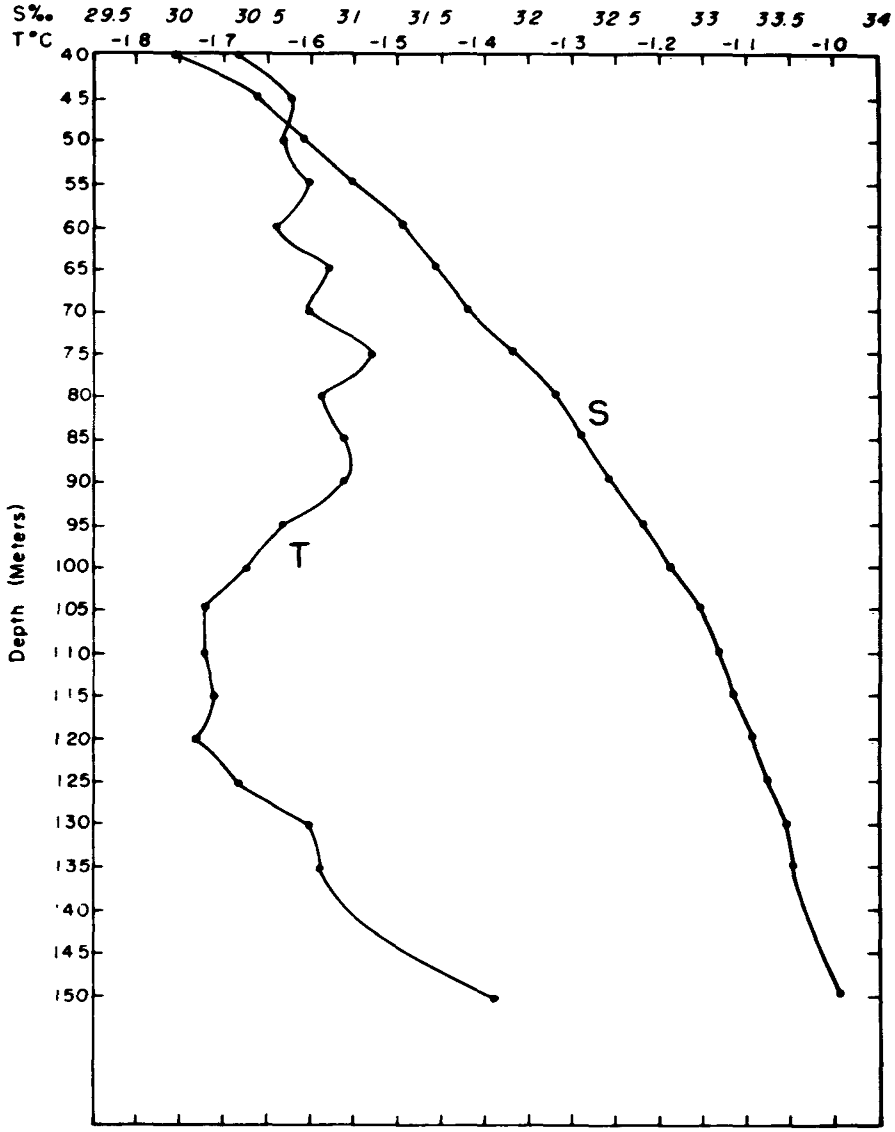
STATION NO 84 (83)

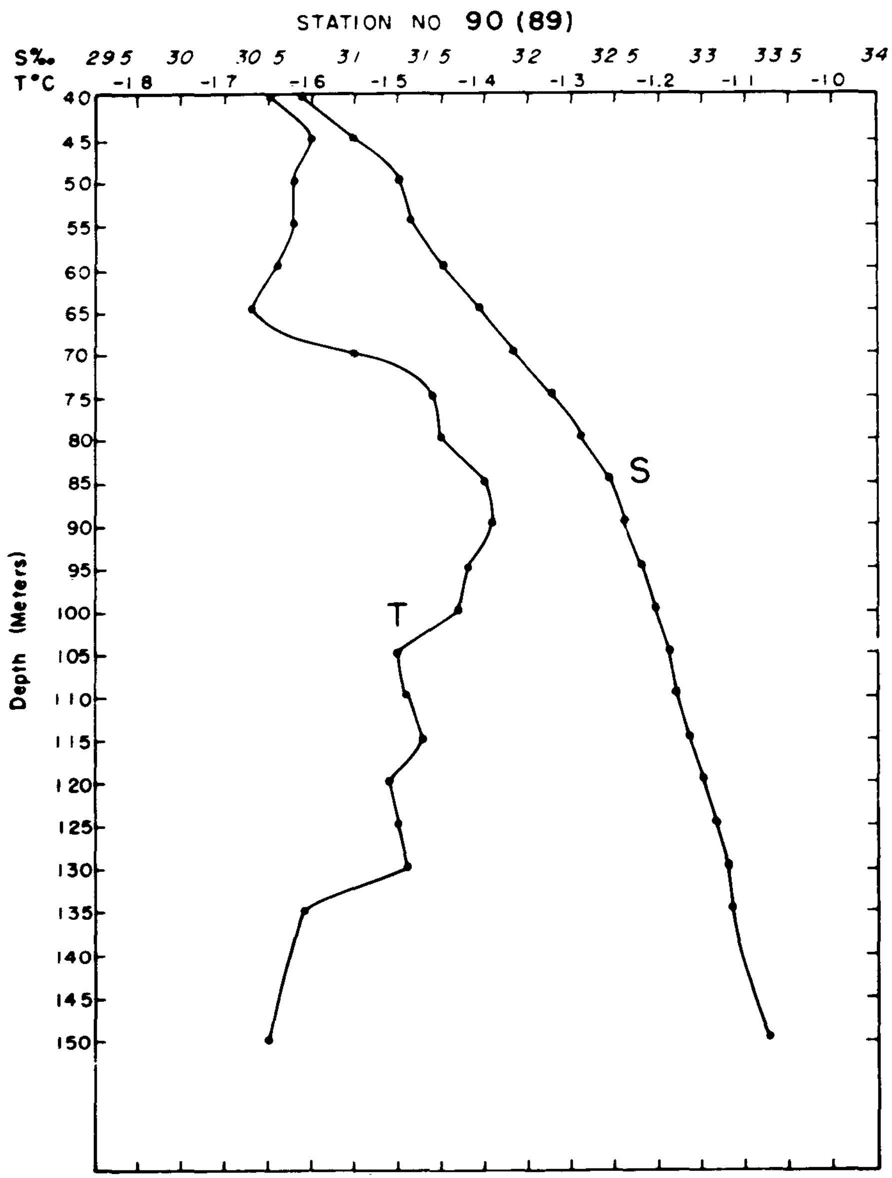


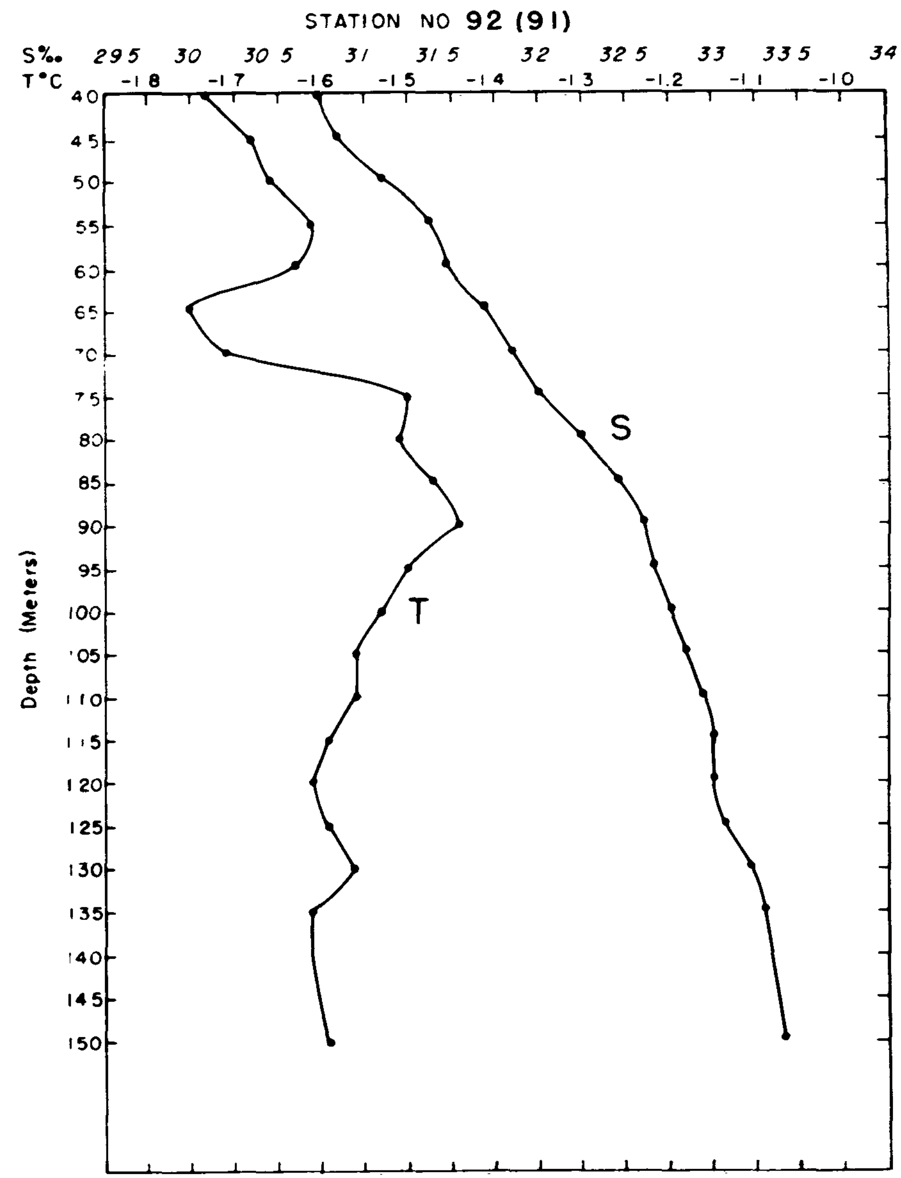
STATION NO 86 (85)



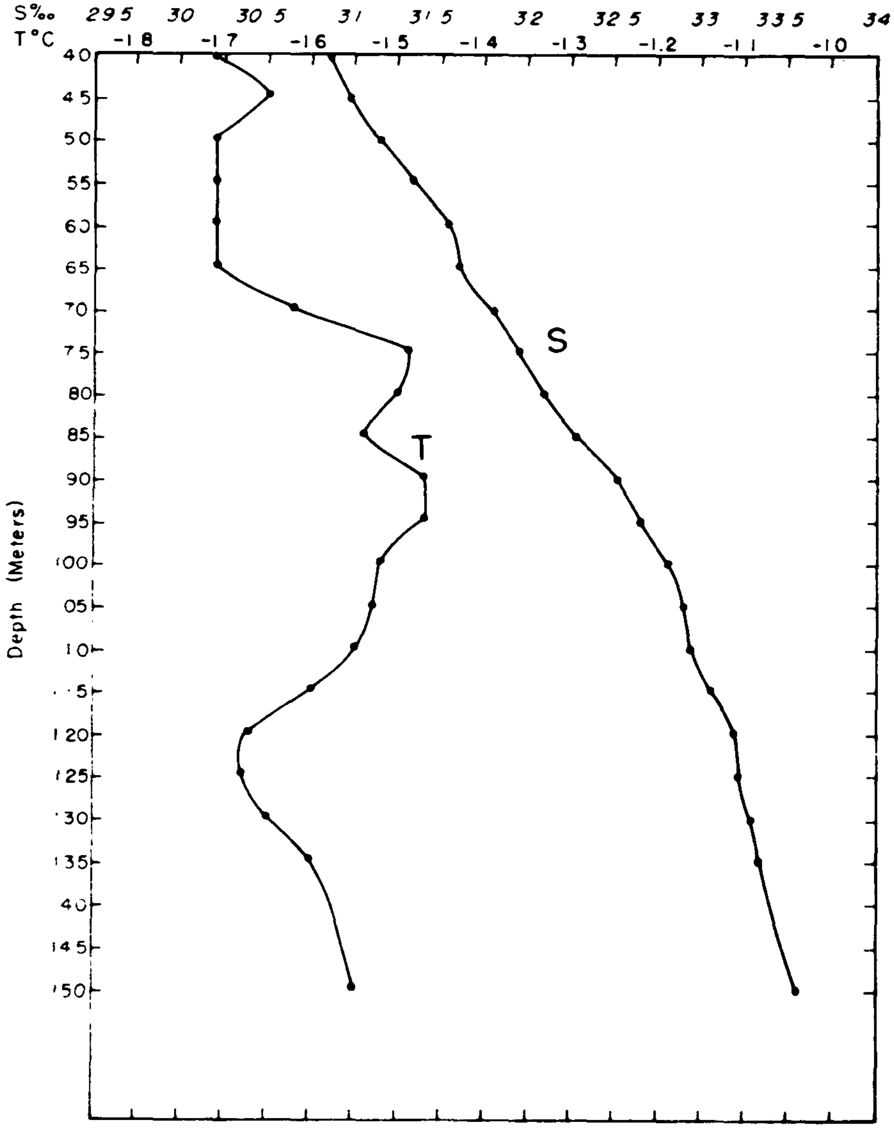
STATION NO 88 (87)



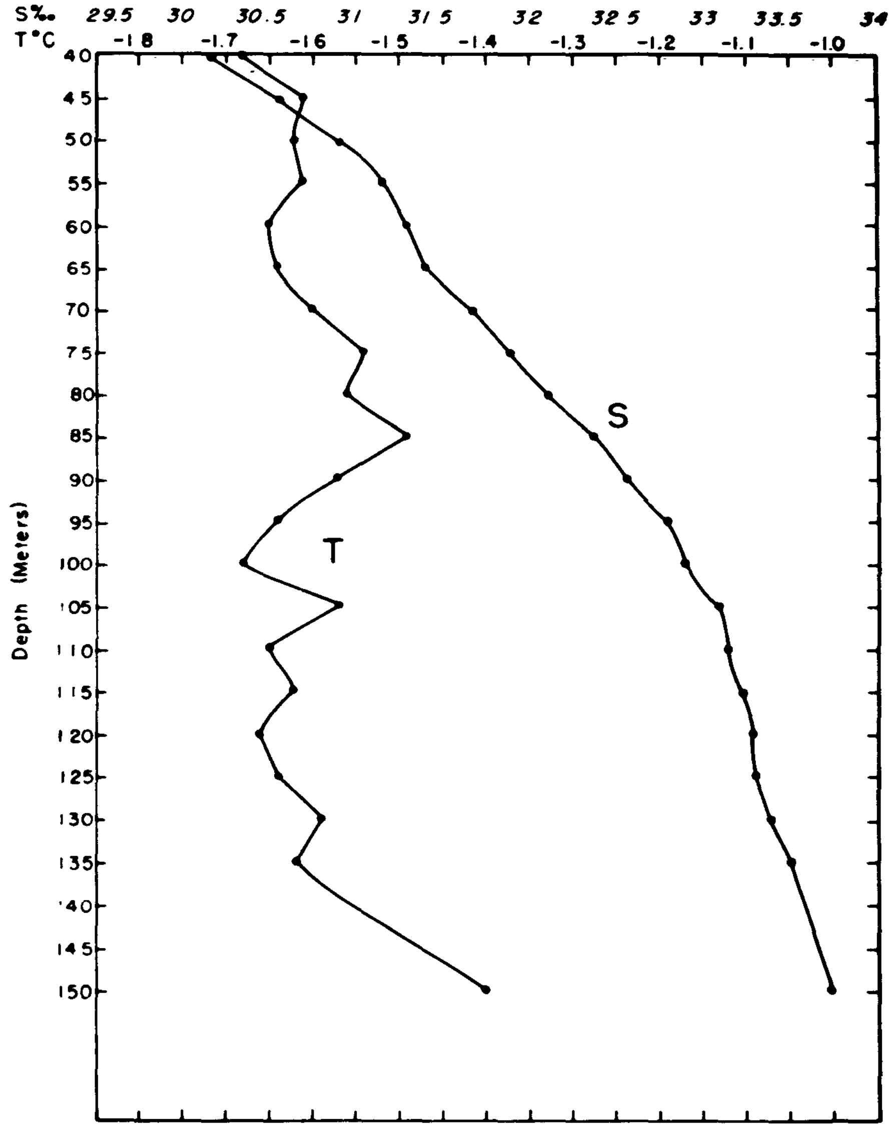

STATION NO 90 (89)
S‰
T°C
29.5 30 30.5 31 31.5 32 32.5 33 33.5 34
-1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1 -1.0
Depth (Meters)
40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150
S
T


STATION NO 92 (91)
S‰
T°C
29.5 30 30.5 31 31.5 32 32.5 33 33.5 34
-1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1 -1.0
Depth (Meters)
40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150
S
T

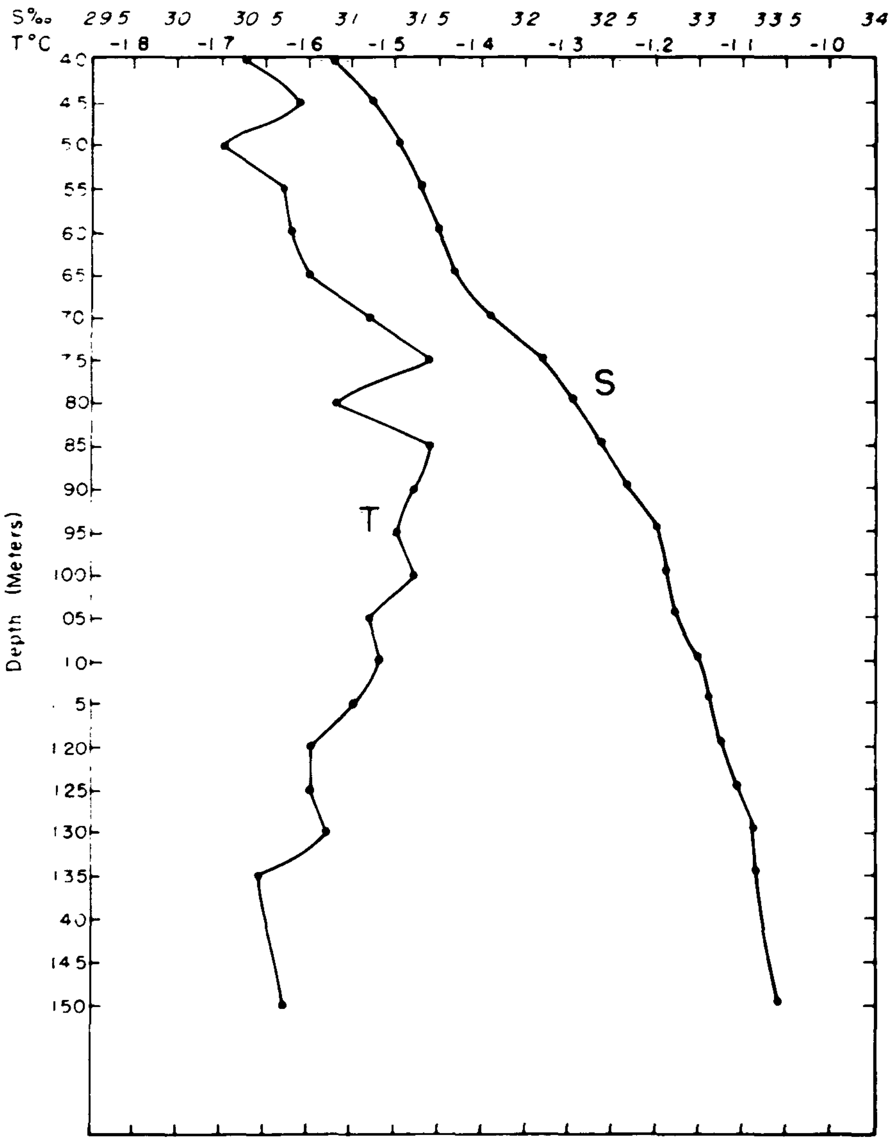
STATION NO 94 (93)



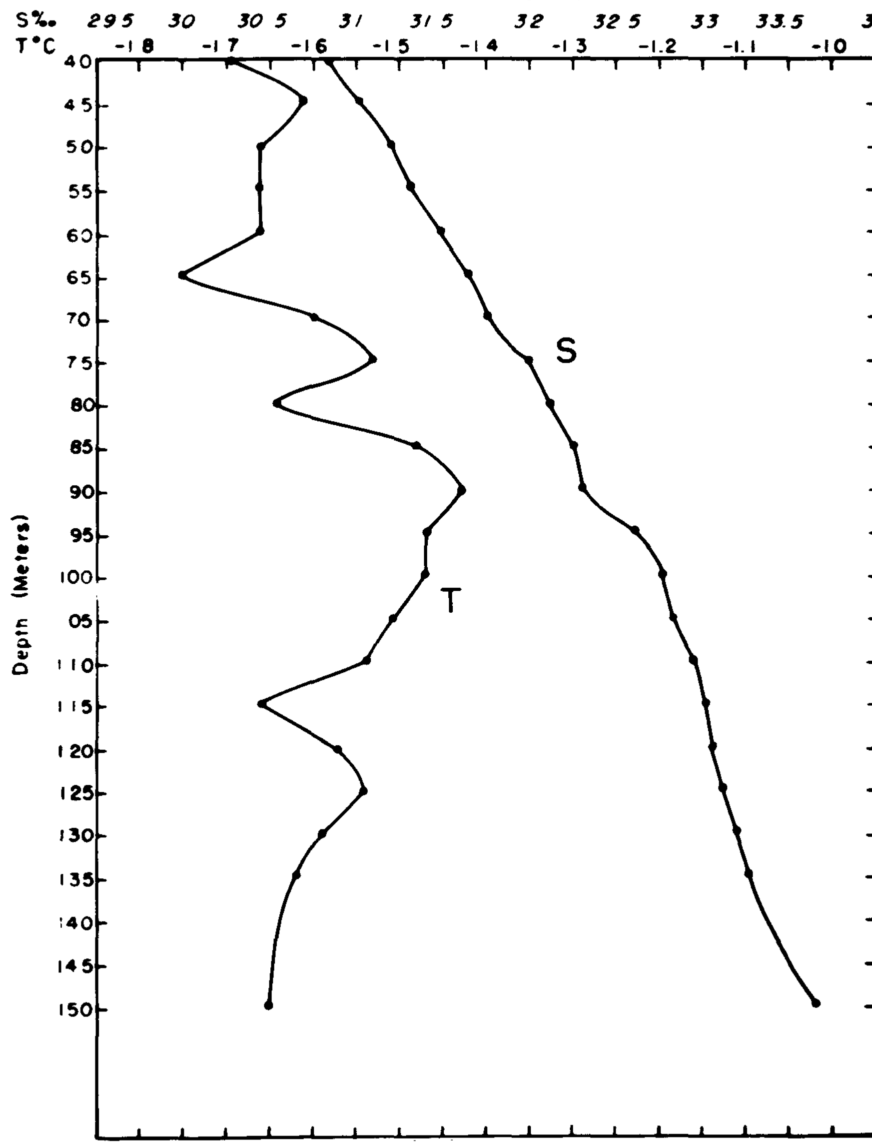
STATION NO. 96 (95)



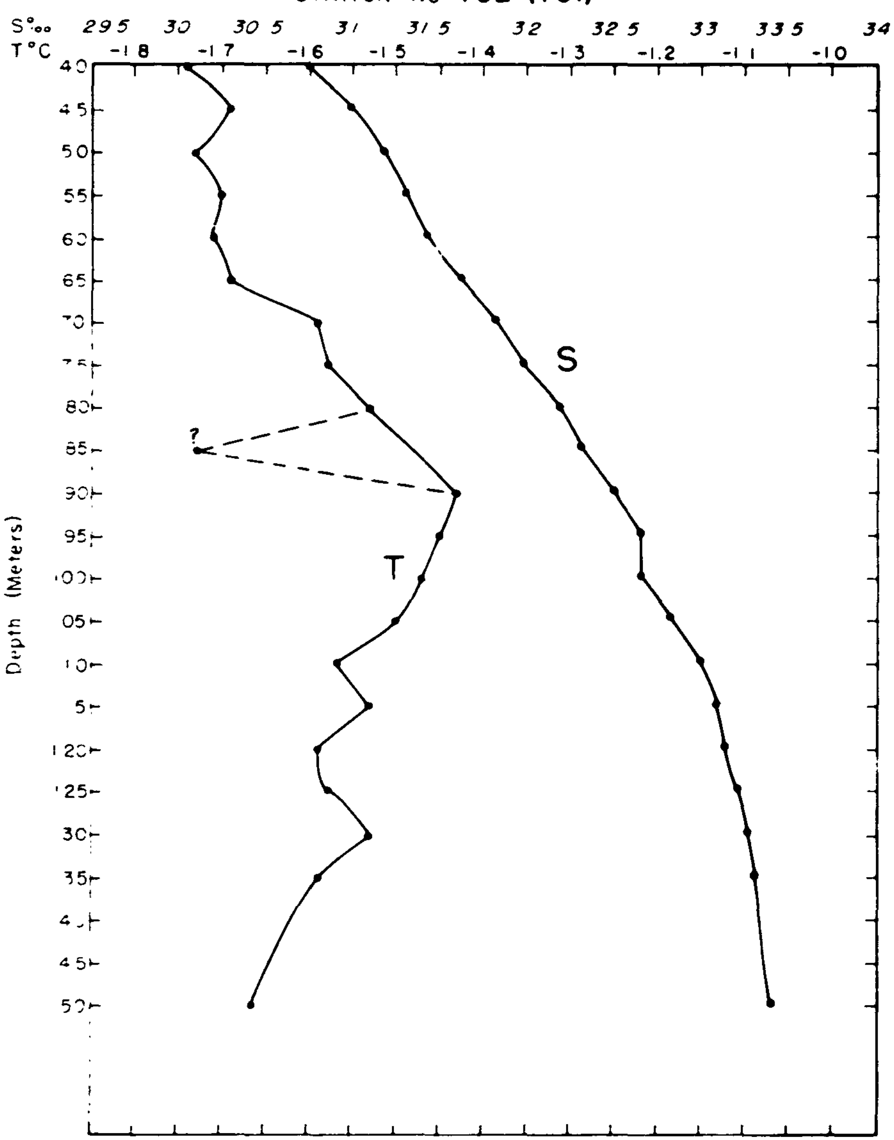
STATION NO 98 (97)



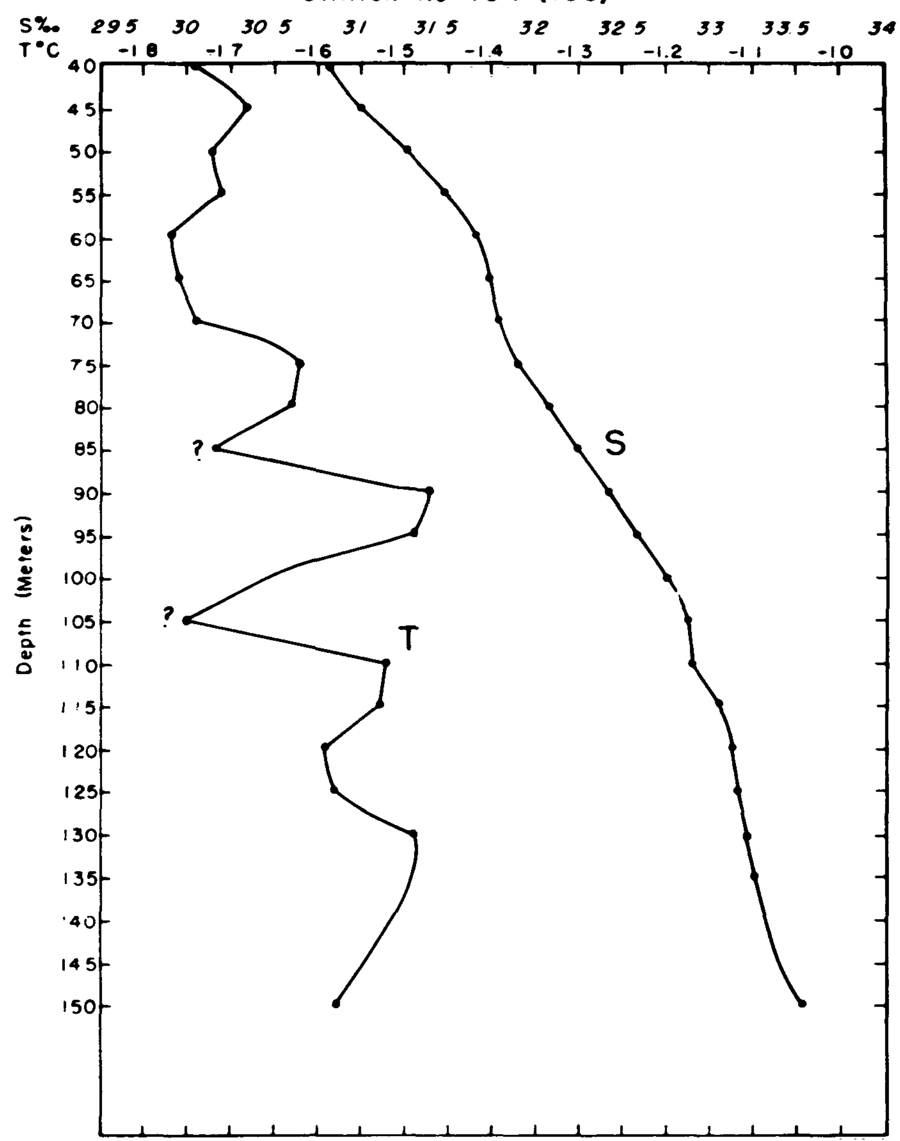
STATION NO 100 (99)



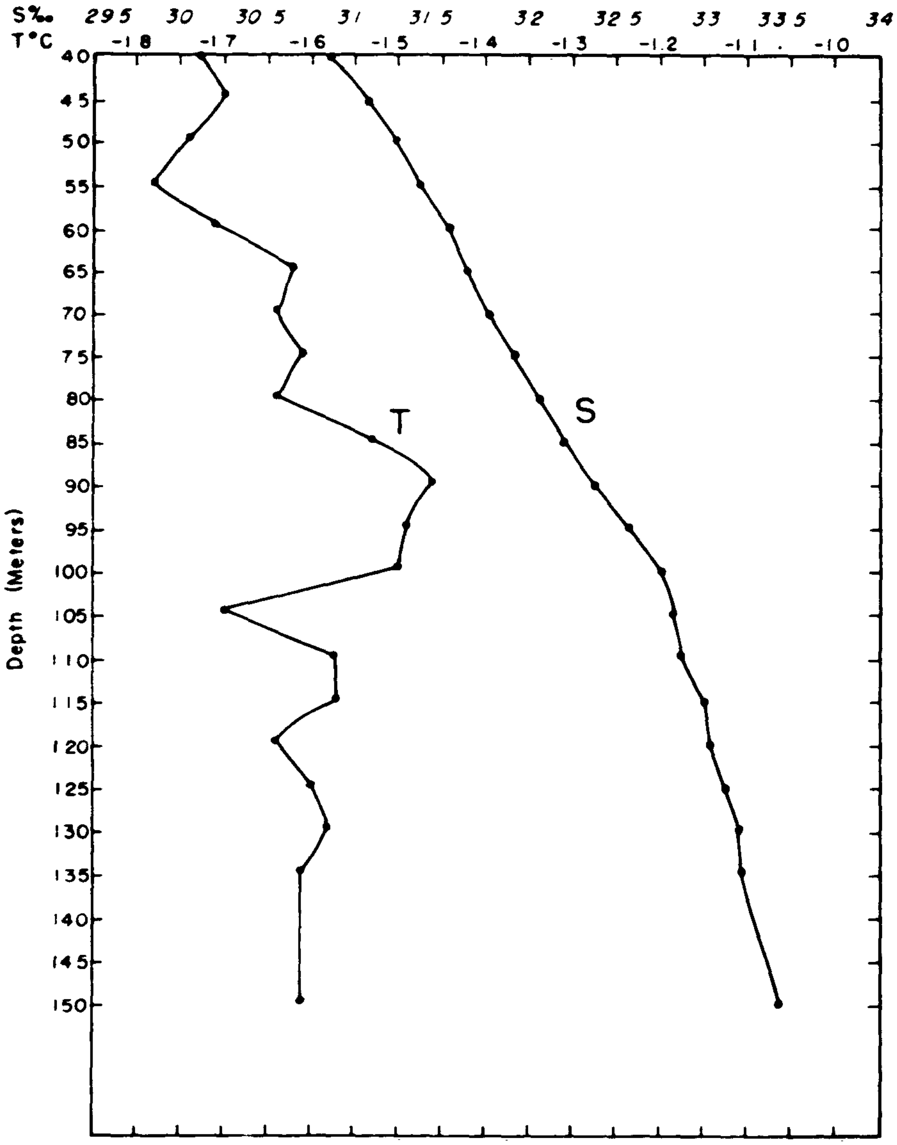
STATION NO 102 (101)



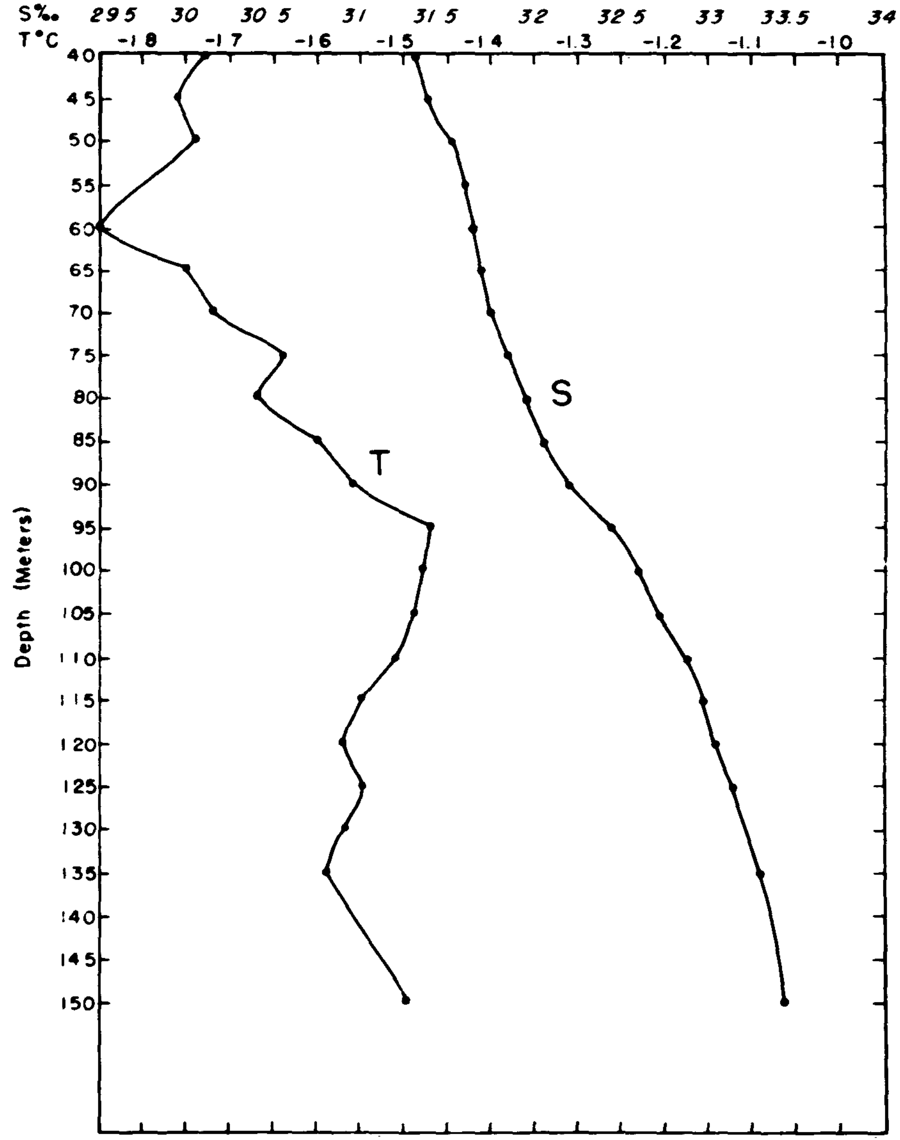
STATION NO 104 (103)



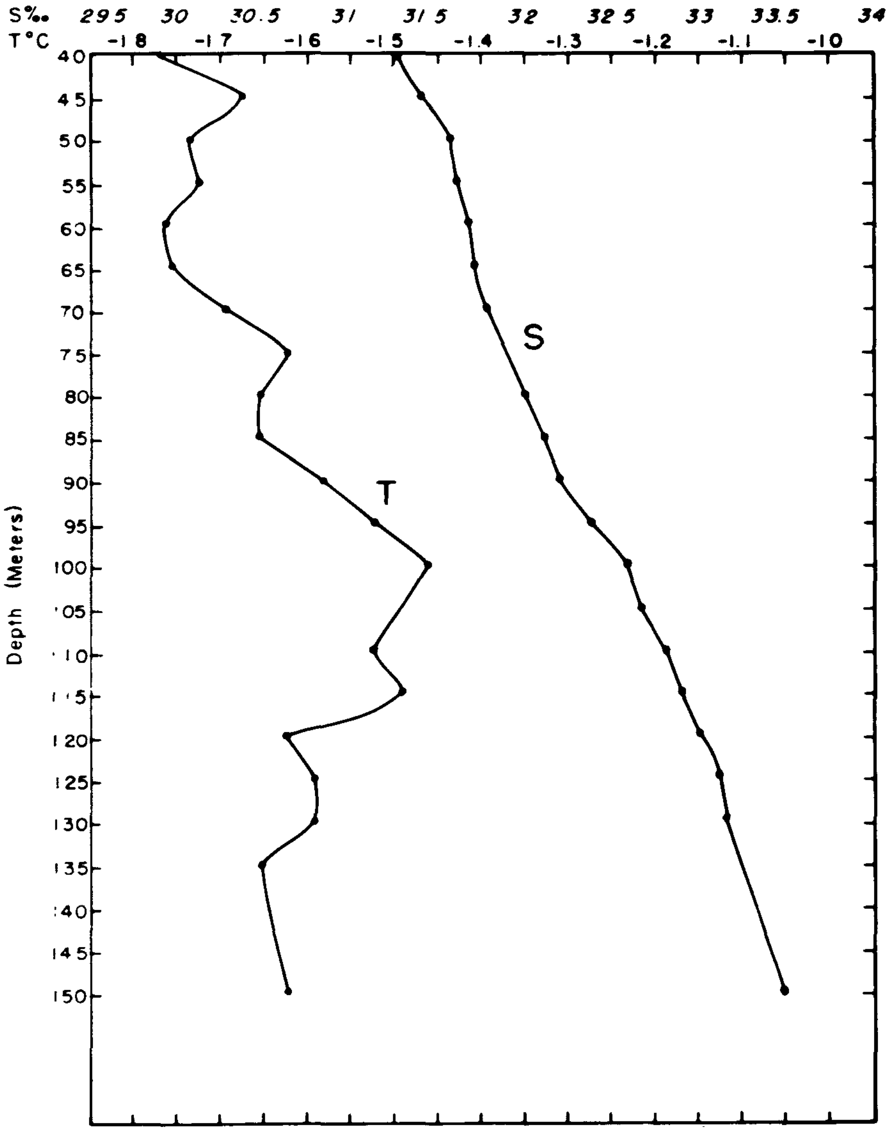
STATION NO 106 (105)



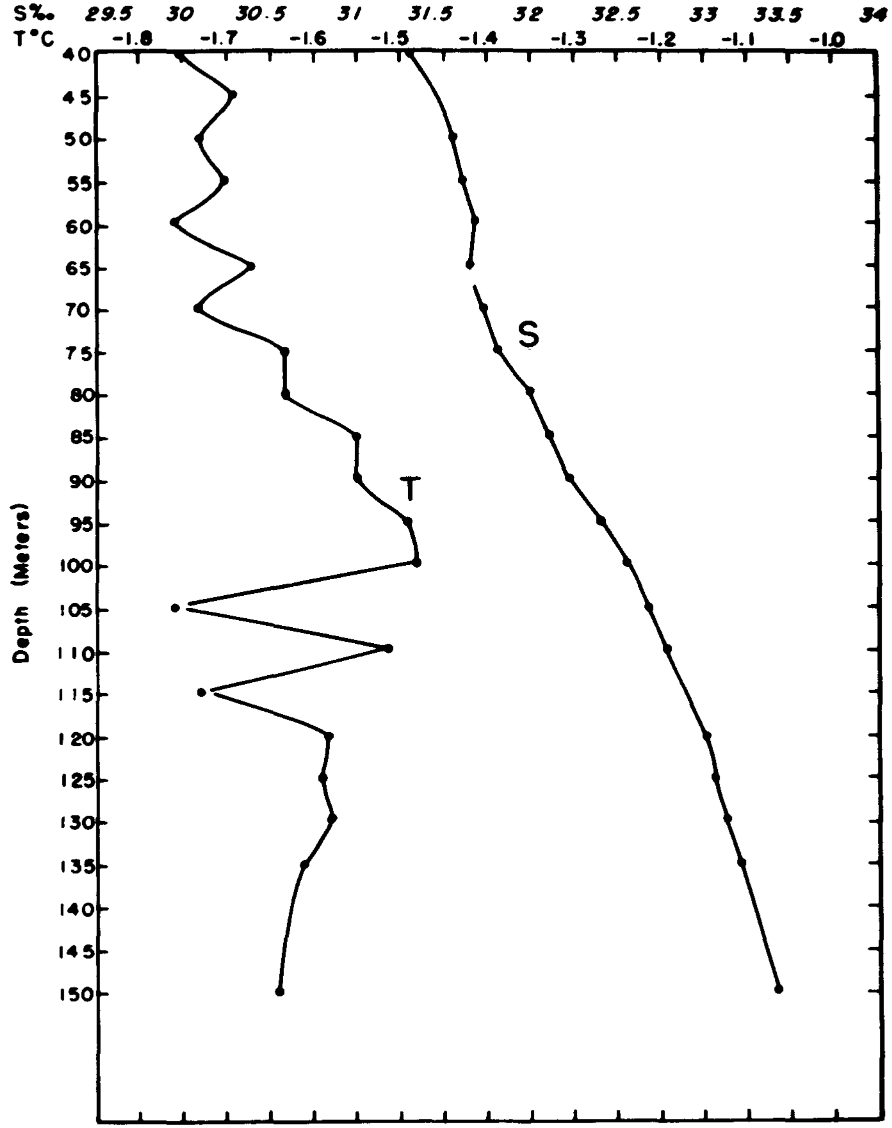
STATION NO 108 (107)



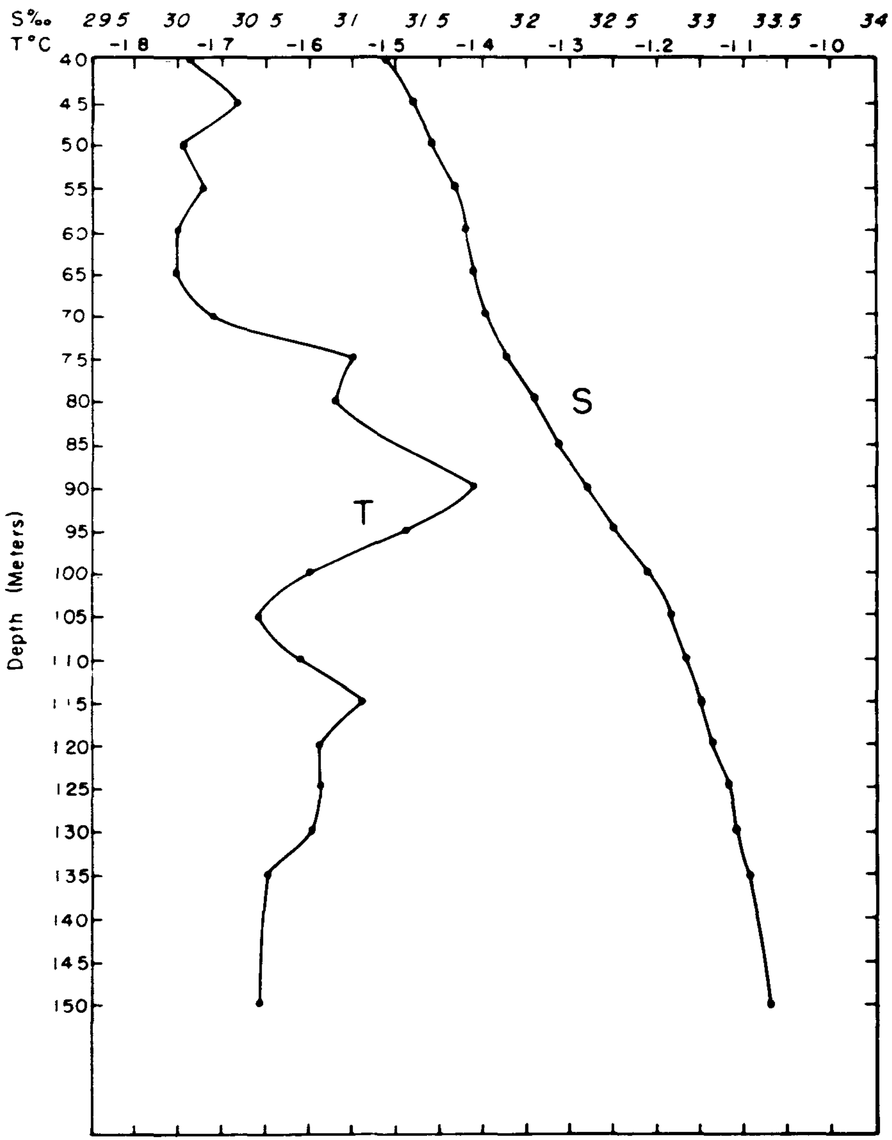
STATION NO 110 (109)



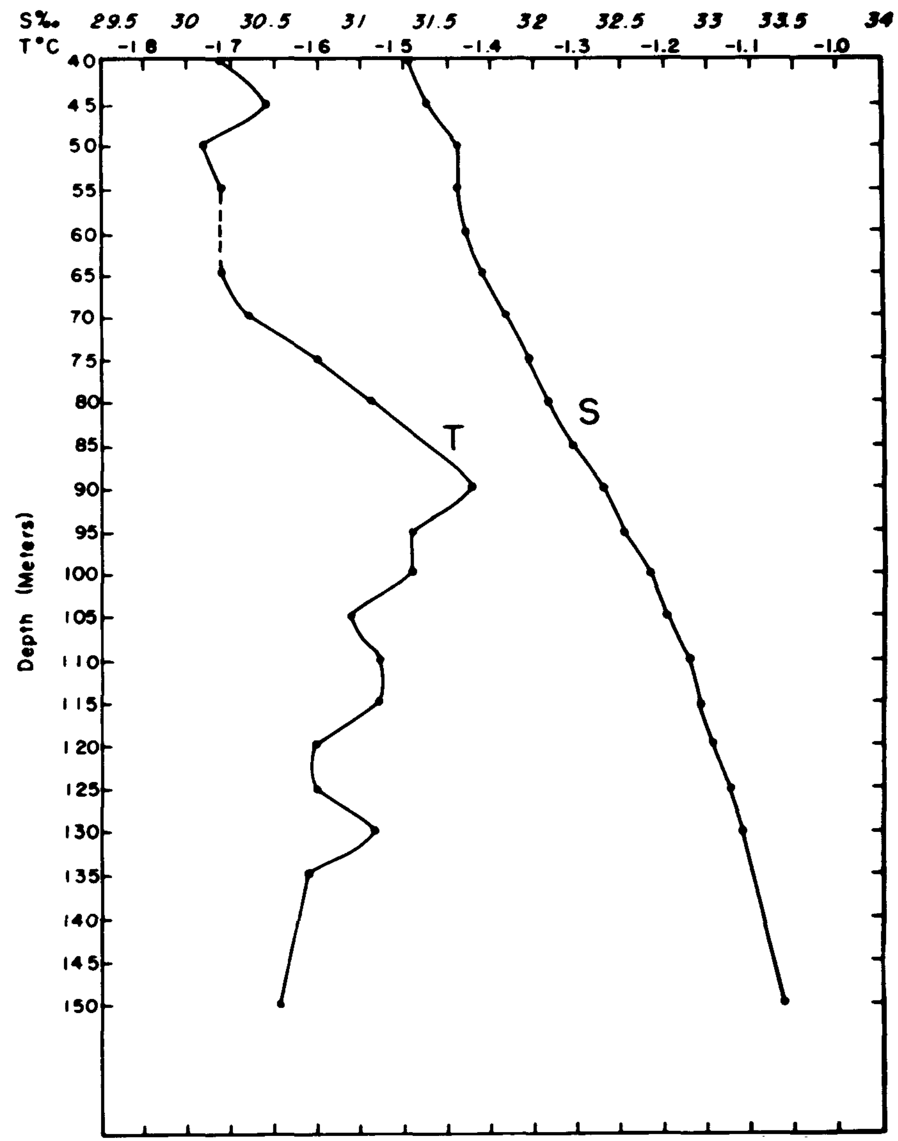
STATION NO. 112 (111)

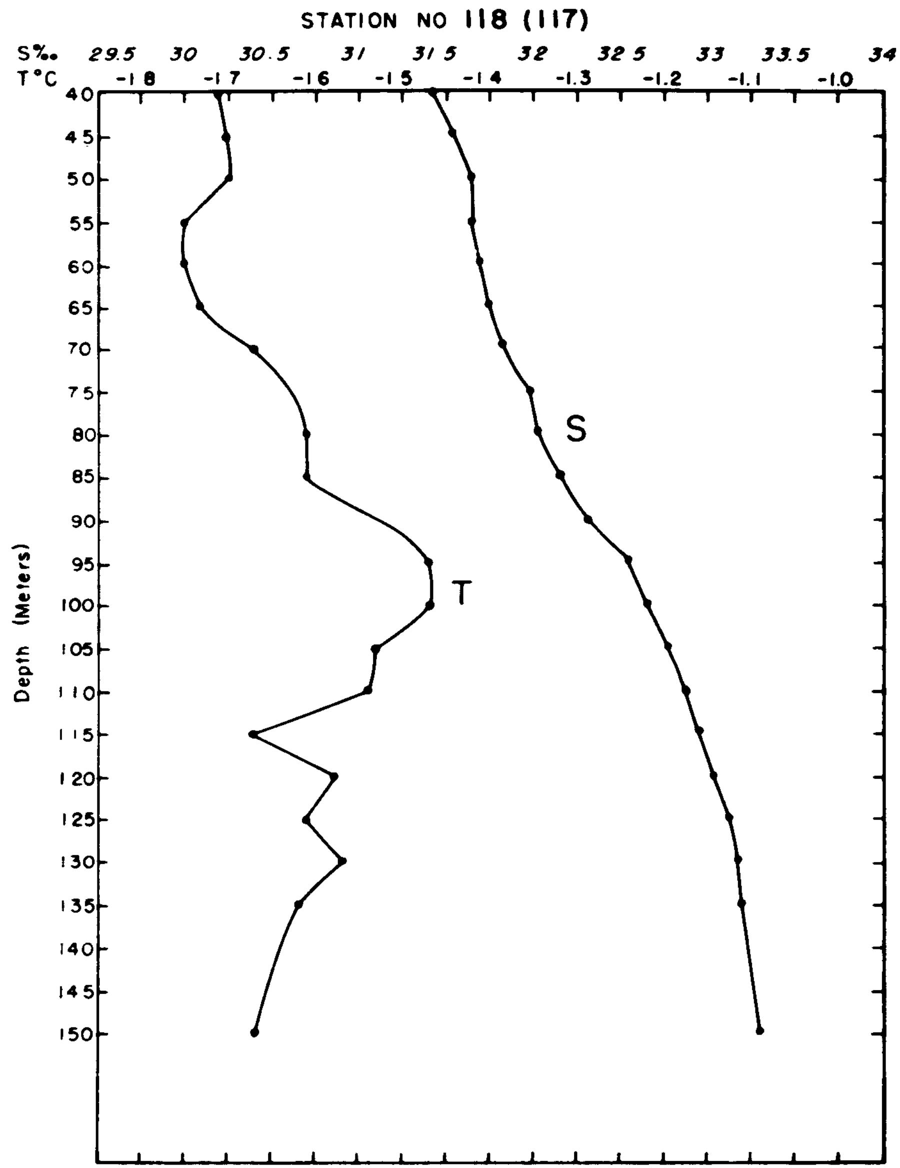


STATION NO 114 (113)

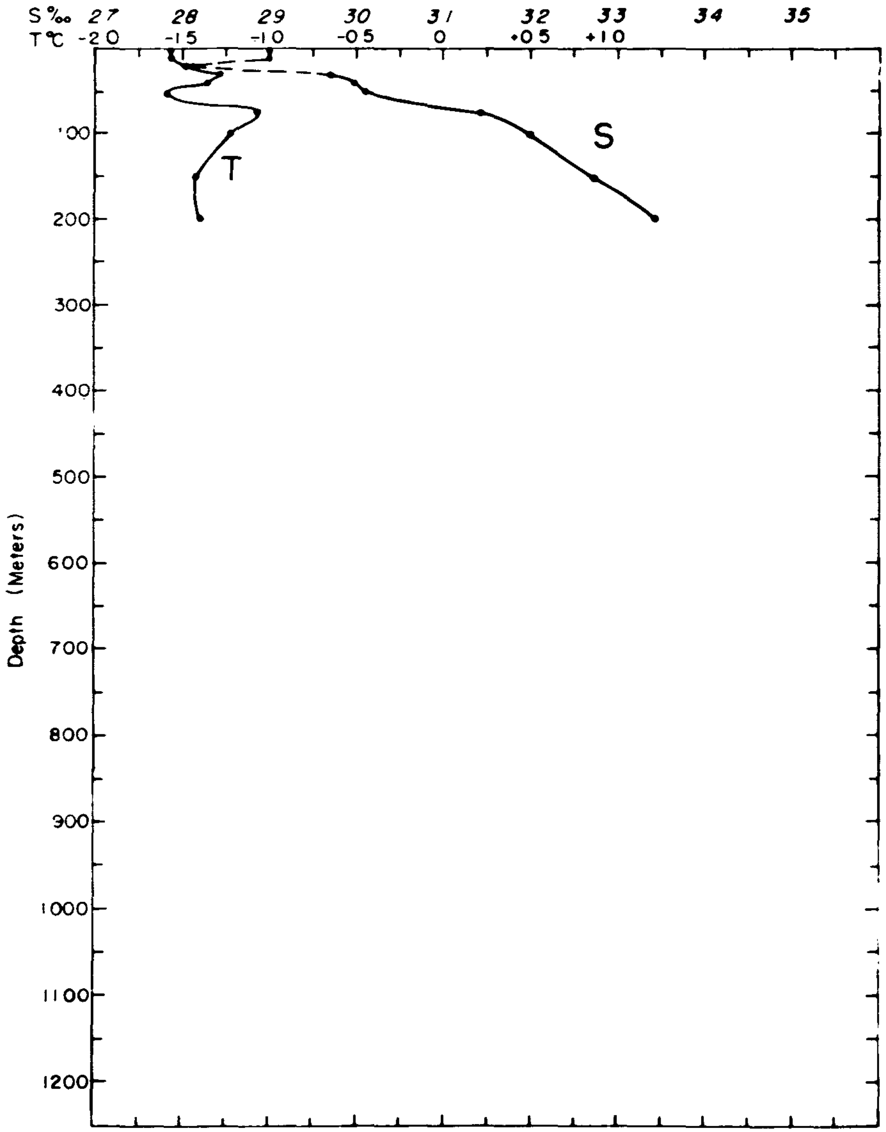


STATION NO. 116 (115)

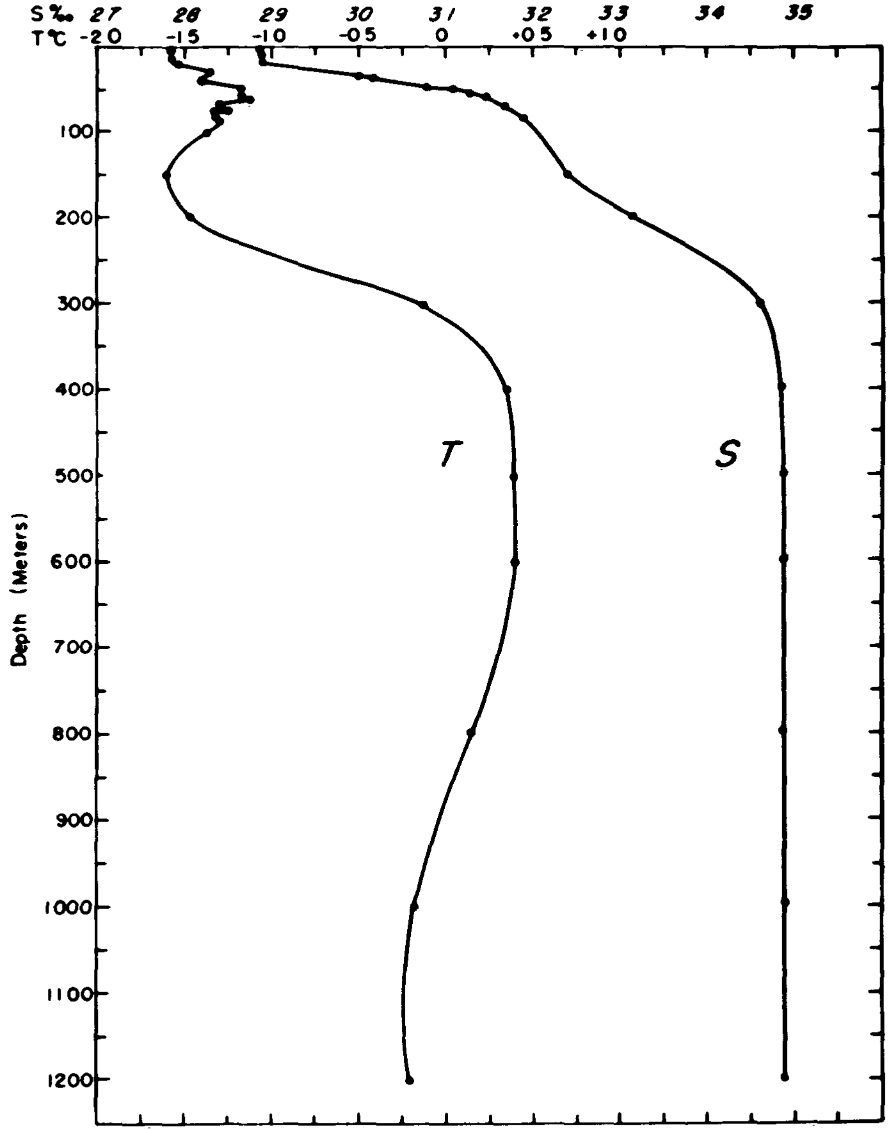



STATION NO 118 (117)
S‰ 29.5 30 30.5 31 31.5 32 32.5 33 33.5 34
T°C -1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1 -1.0
Depth (Meters)
40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150
S
T

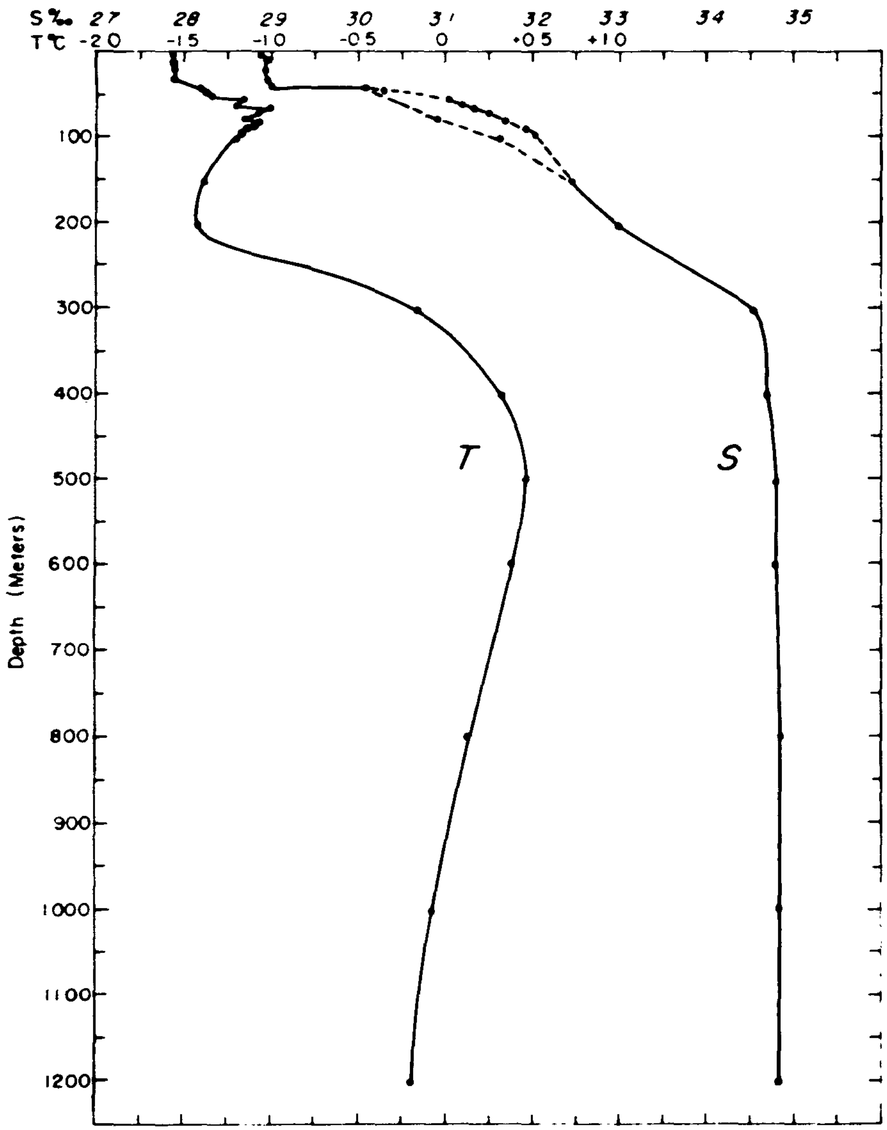
STATION NO. 1



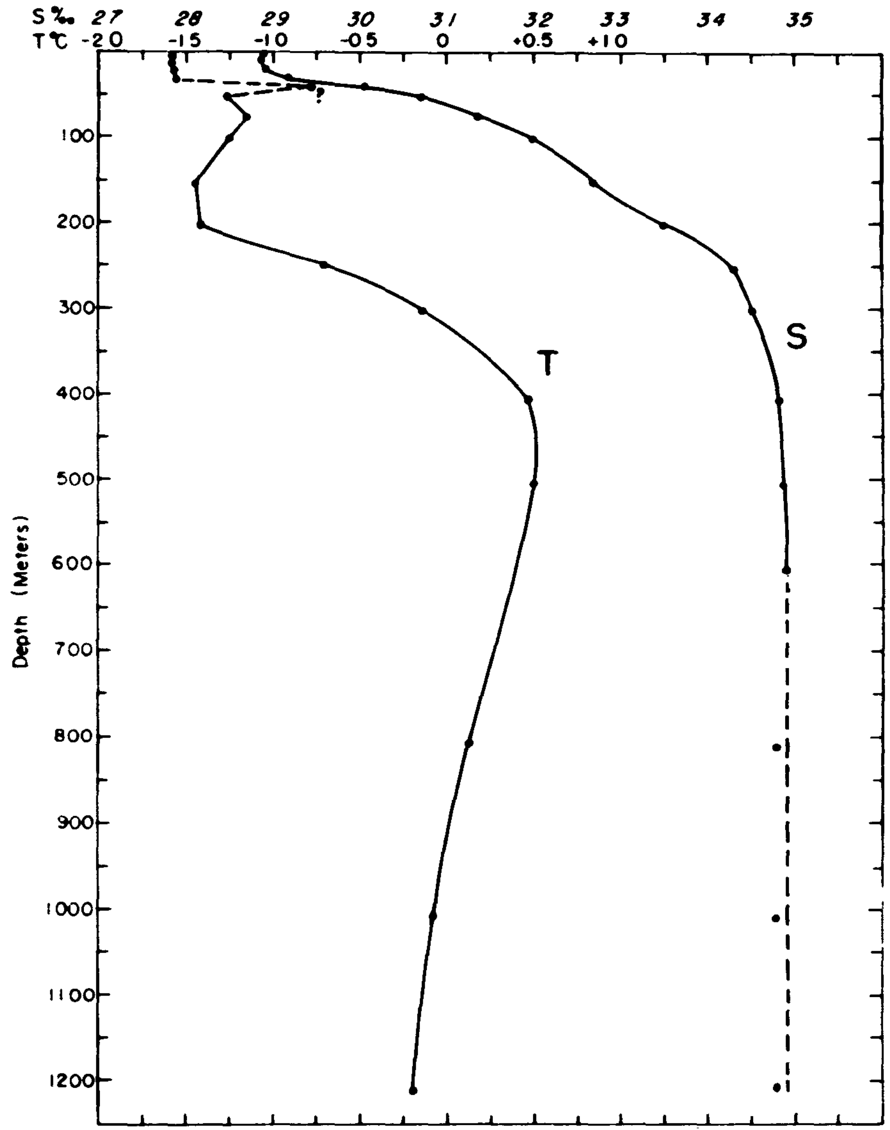
STATION NO. 2+3



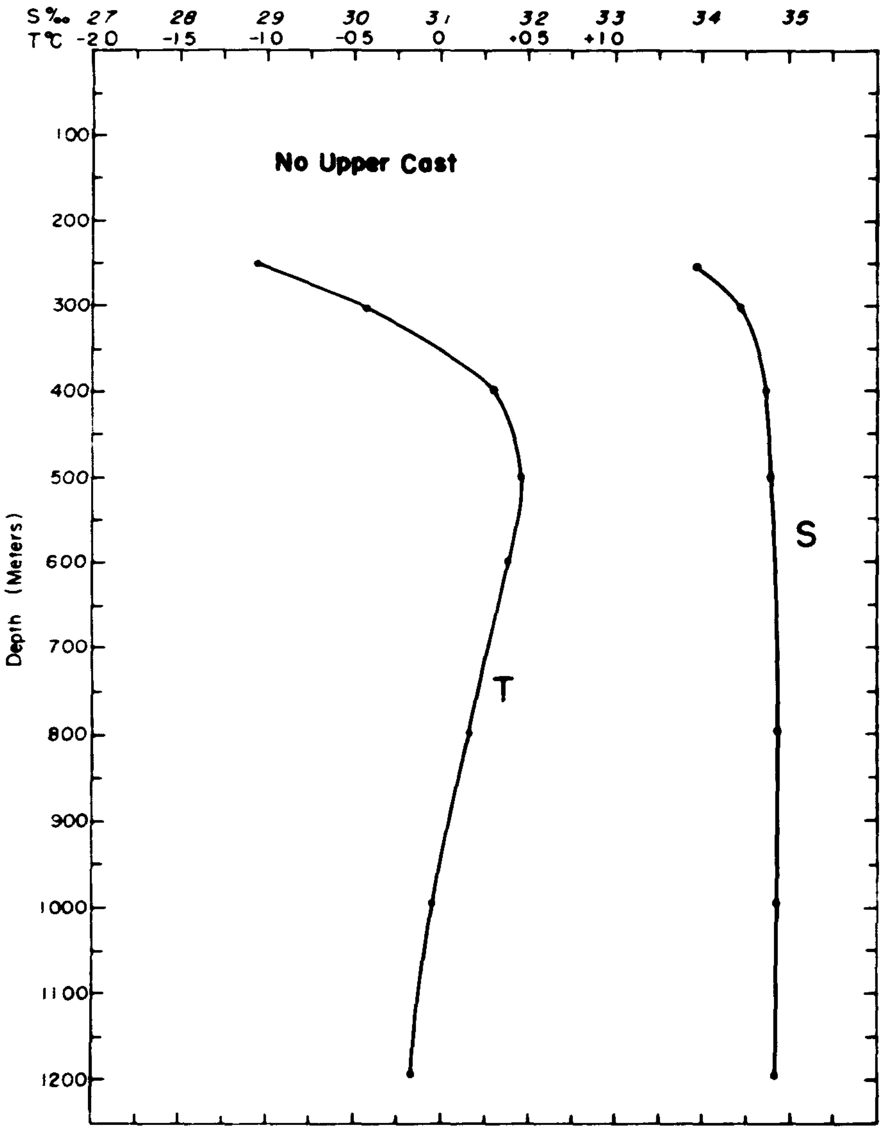
STATION NO. 4 + 5



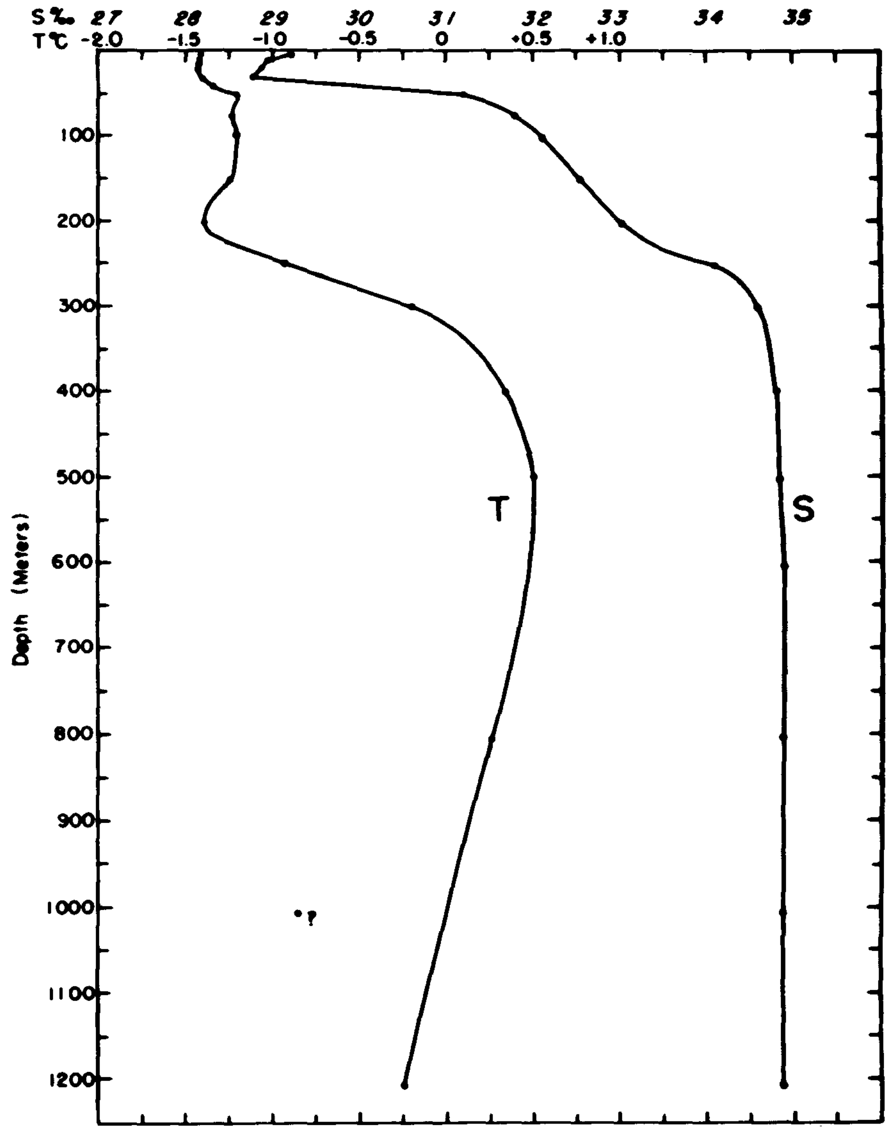
STATION NO. 6

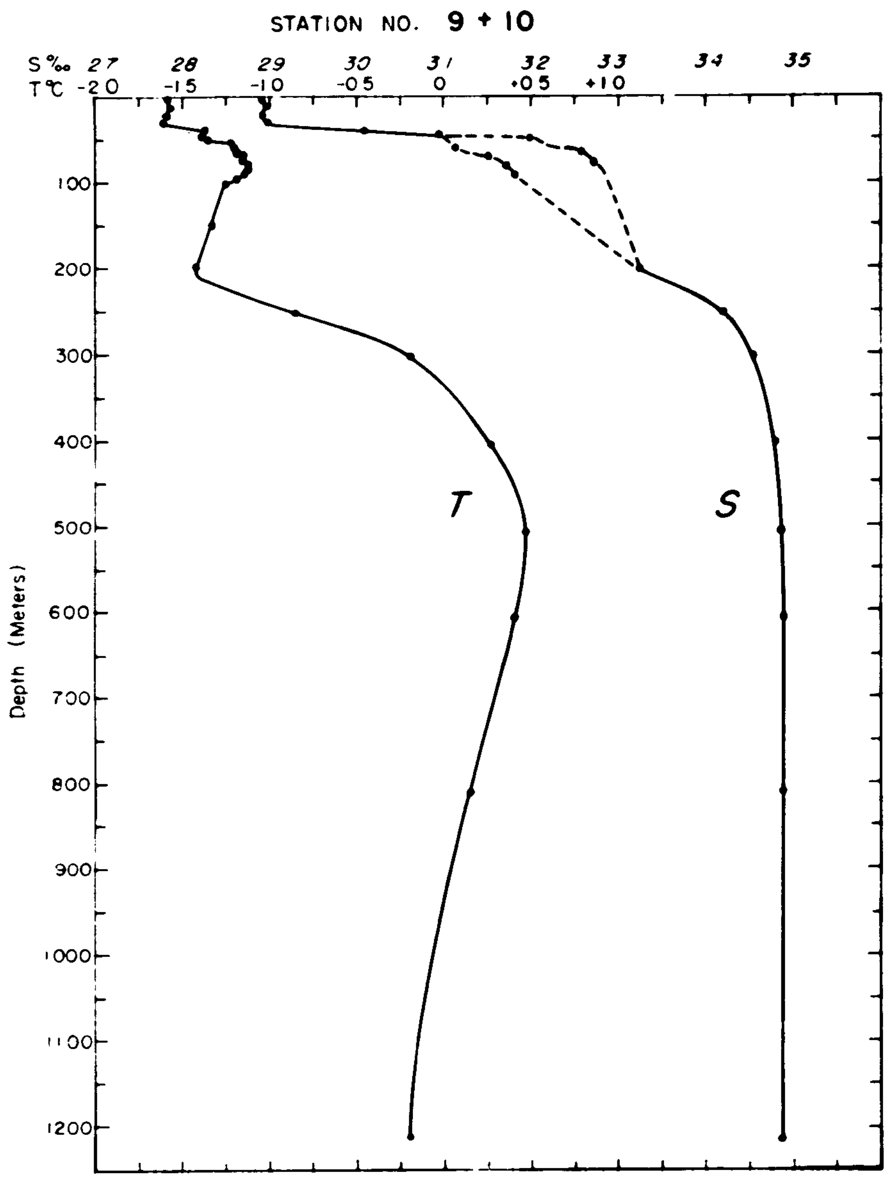


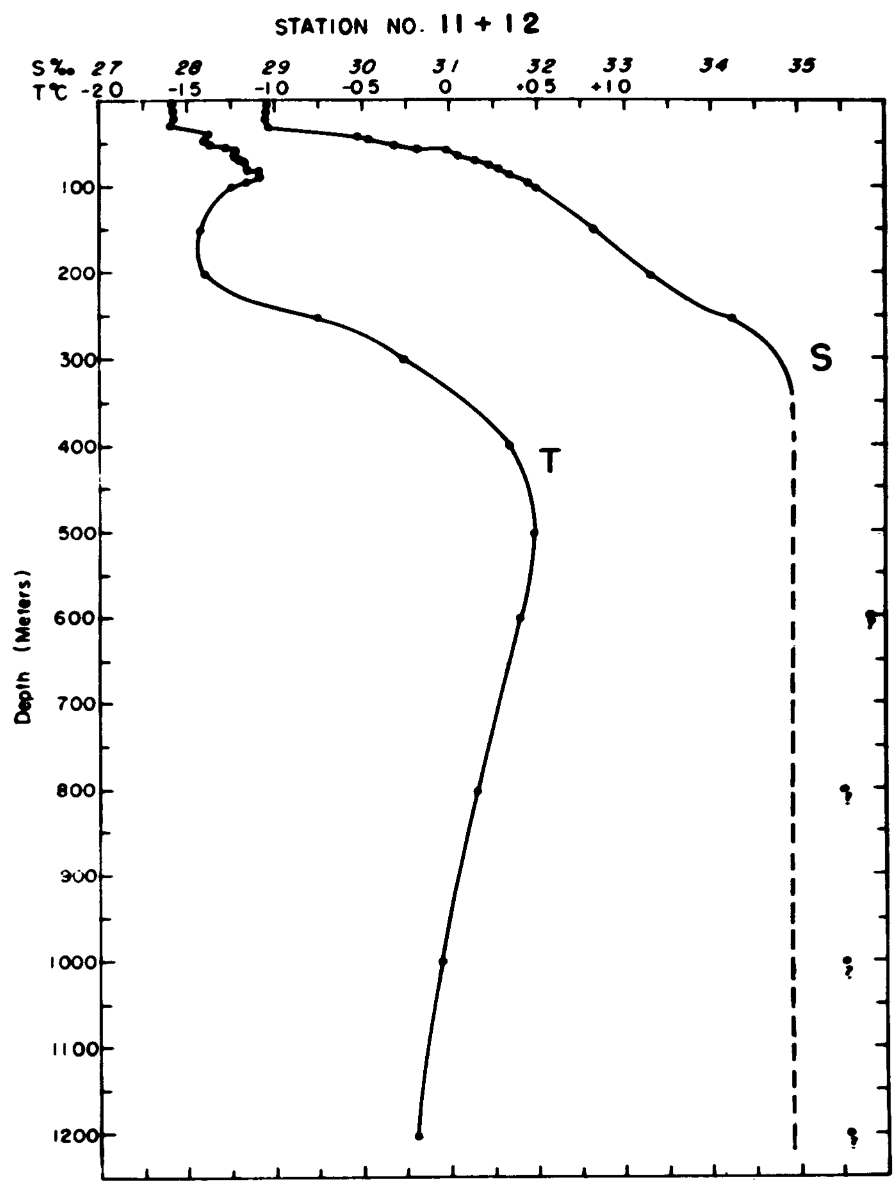
STATION NO. 7



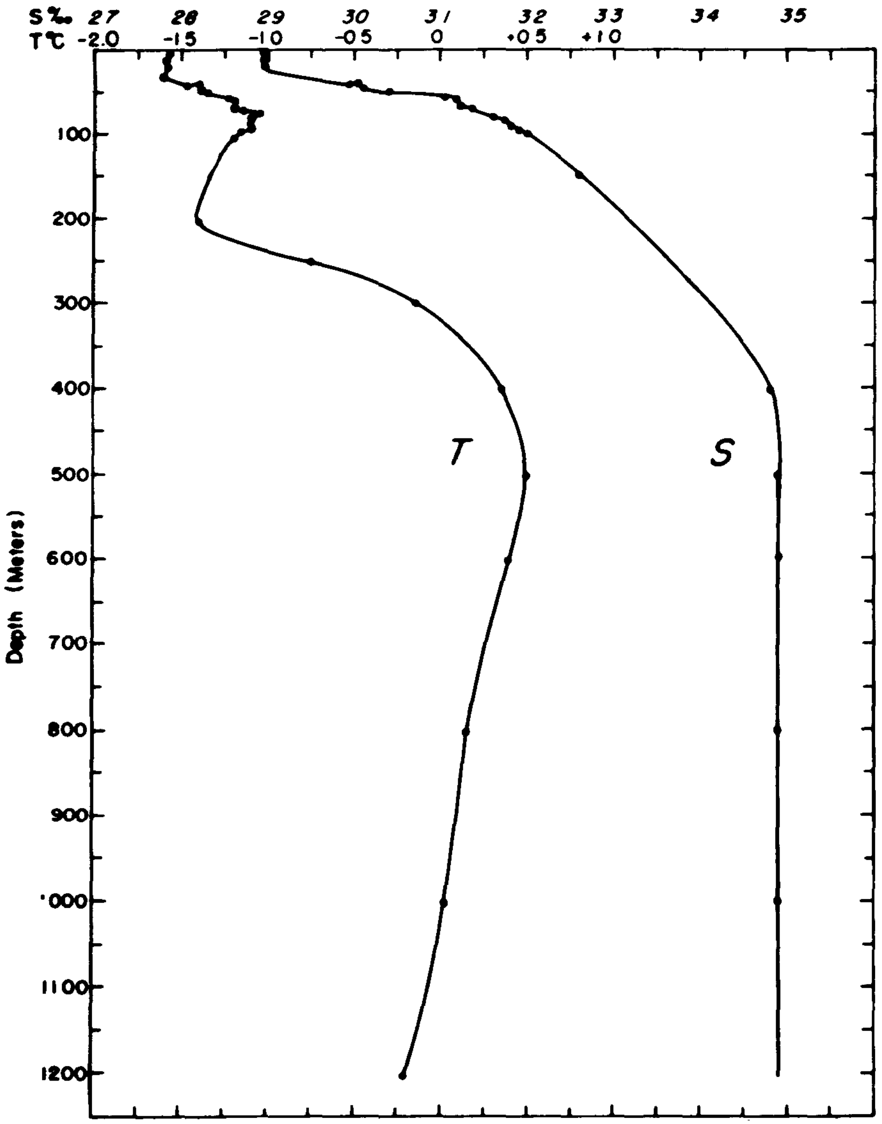
STATION NO. 8



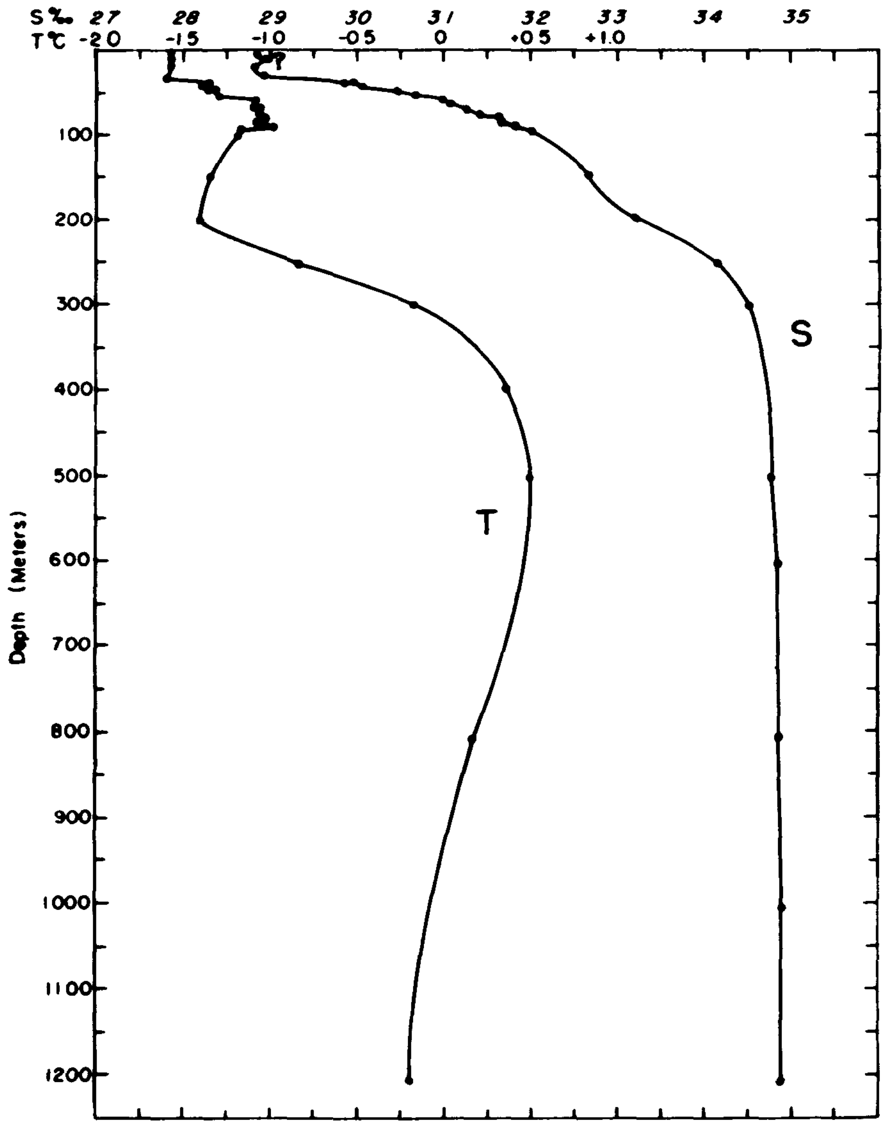

STATION NO. 9 + 10
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
S

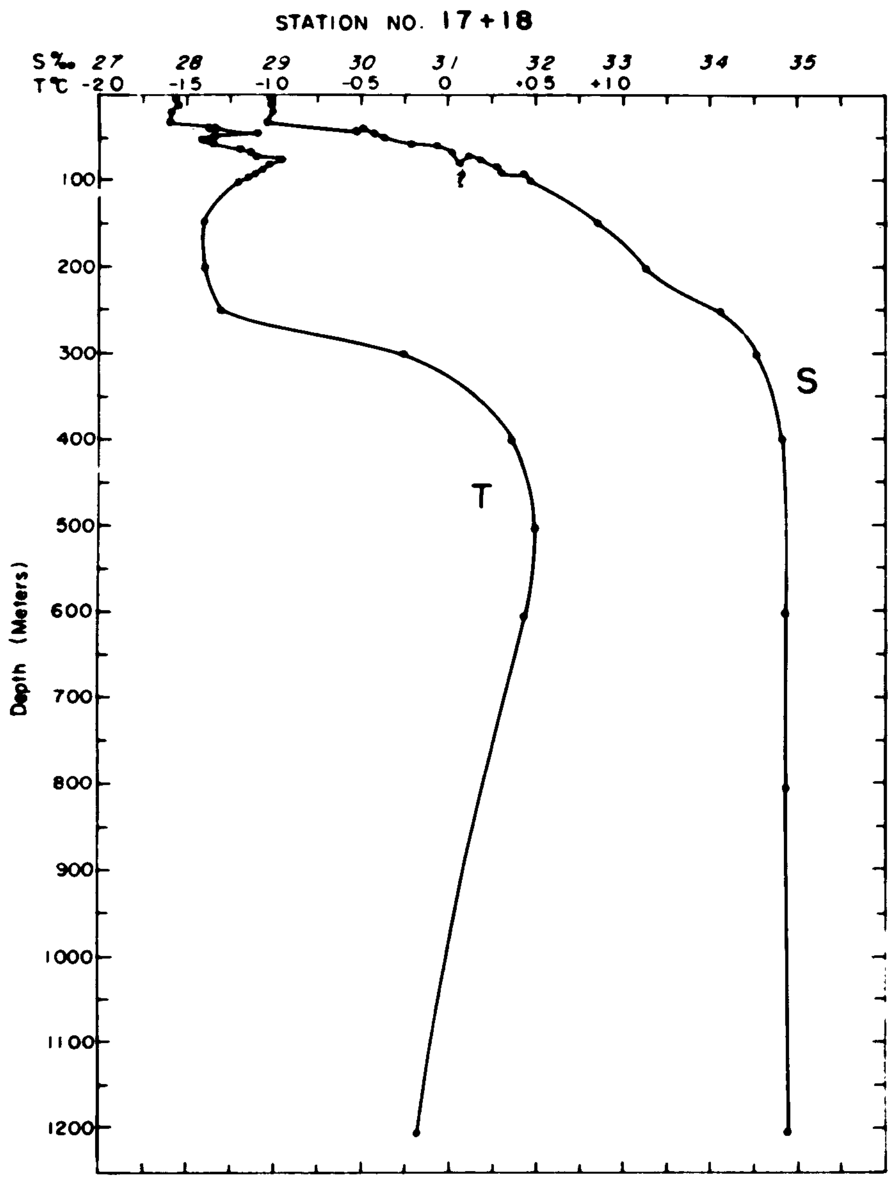

STATION NO. 11 + 12
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
S

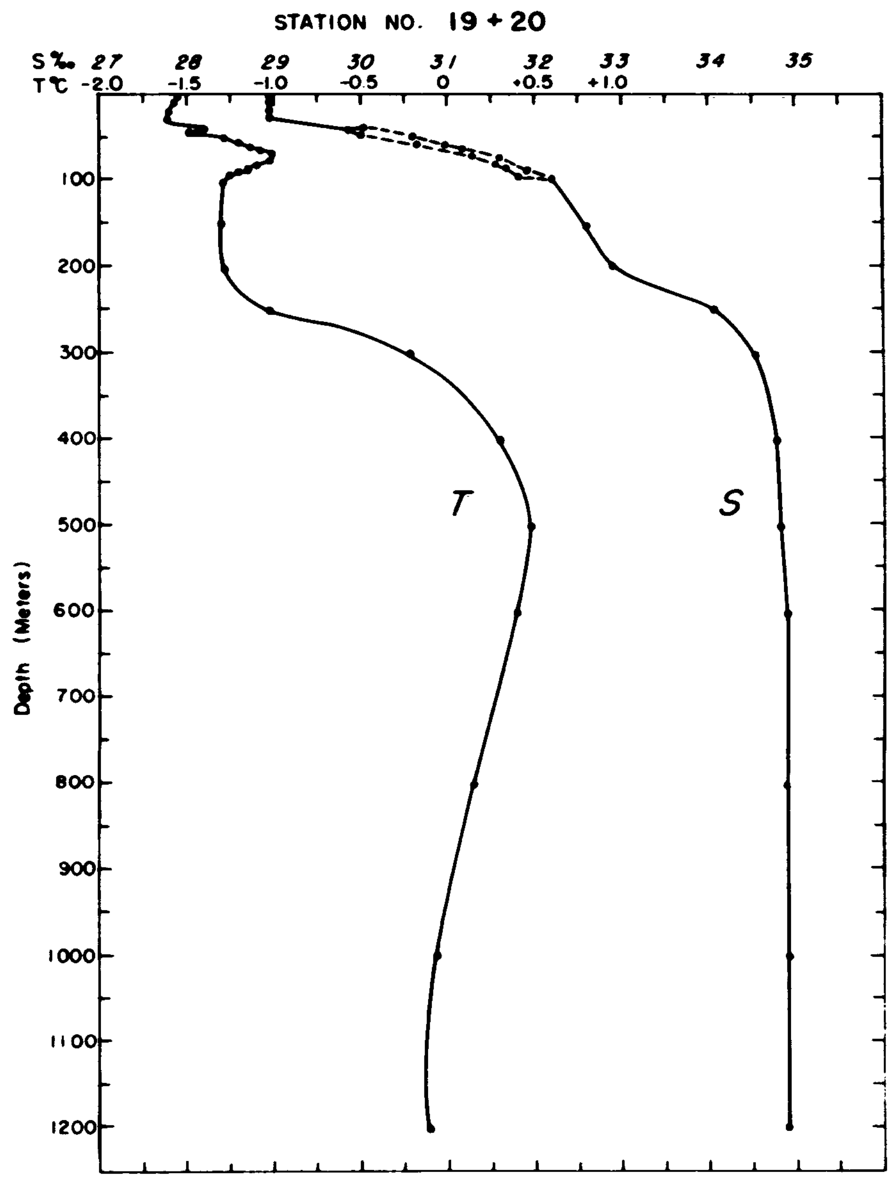
STATION NO. 13 + 14

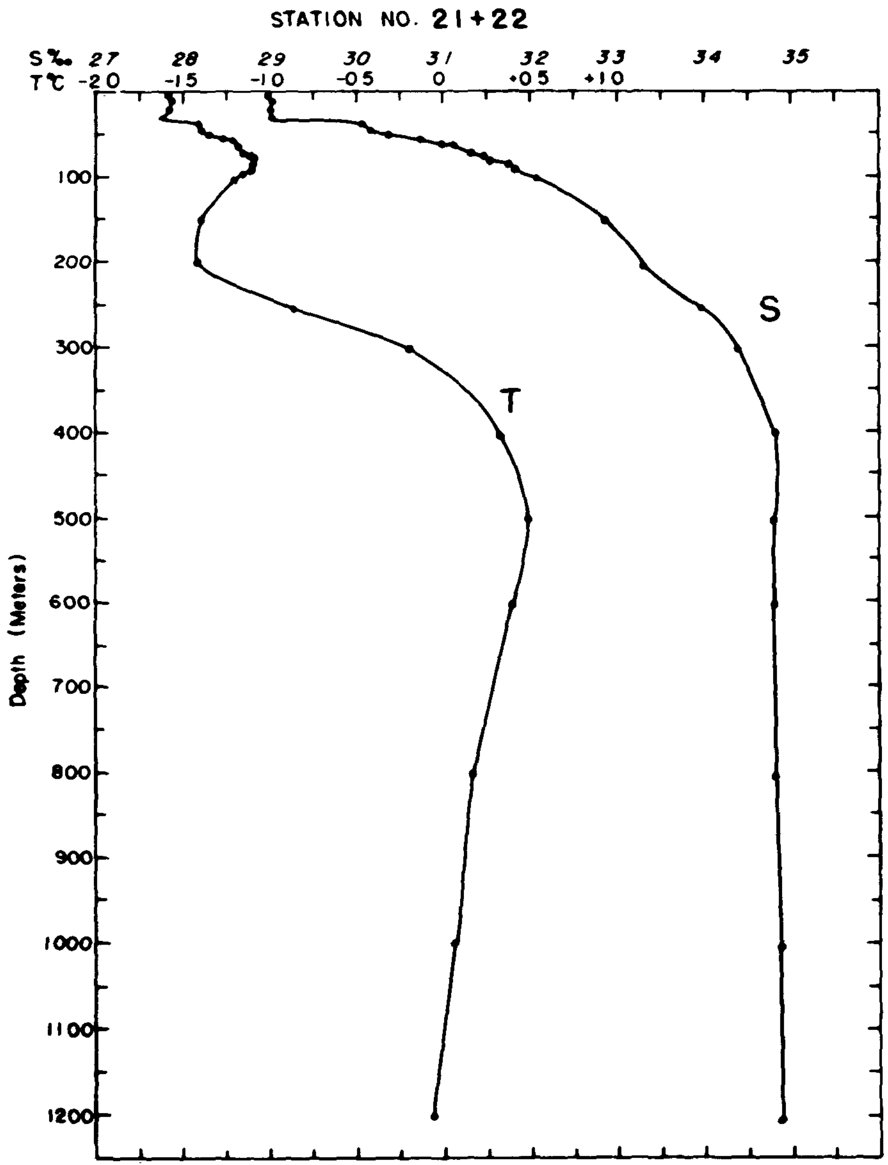


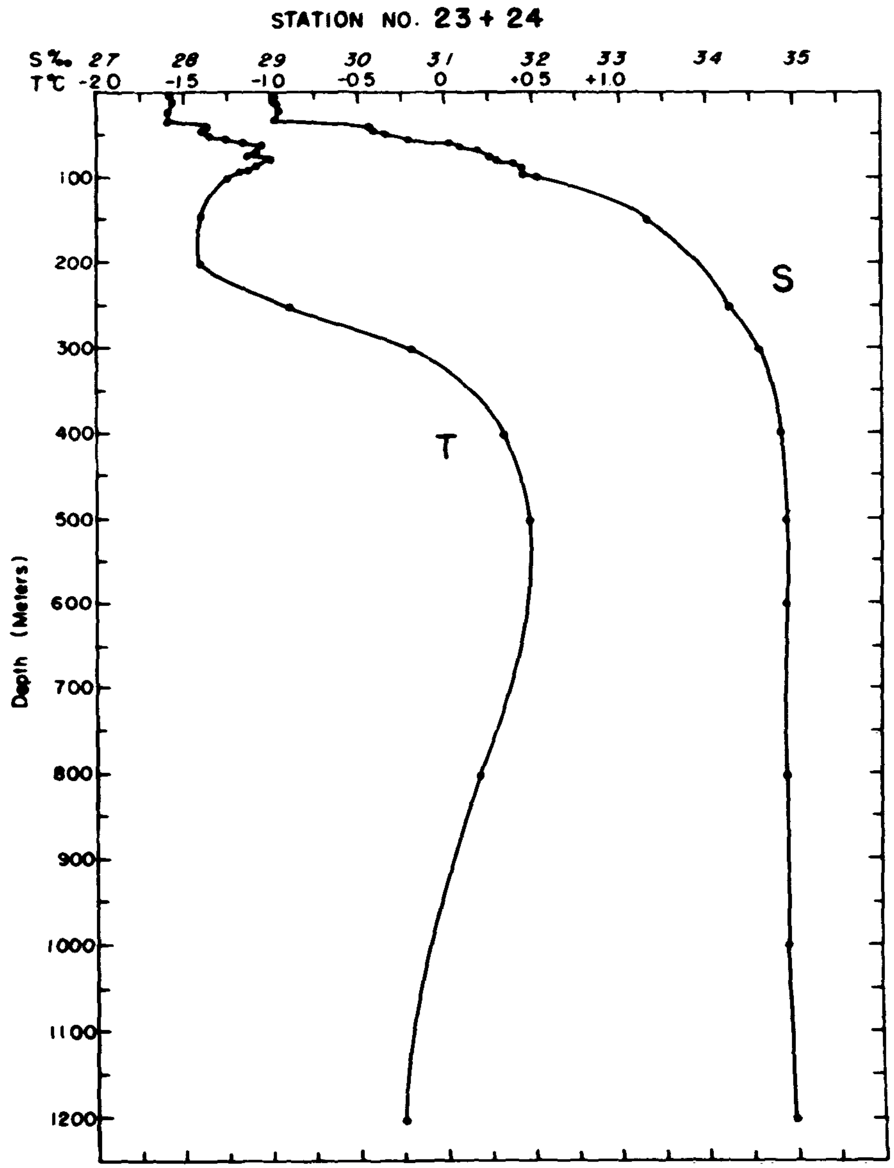
STATION NO. 15 + 16



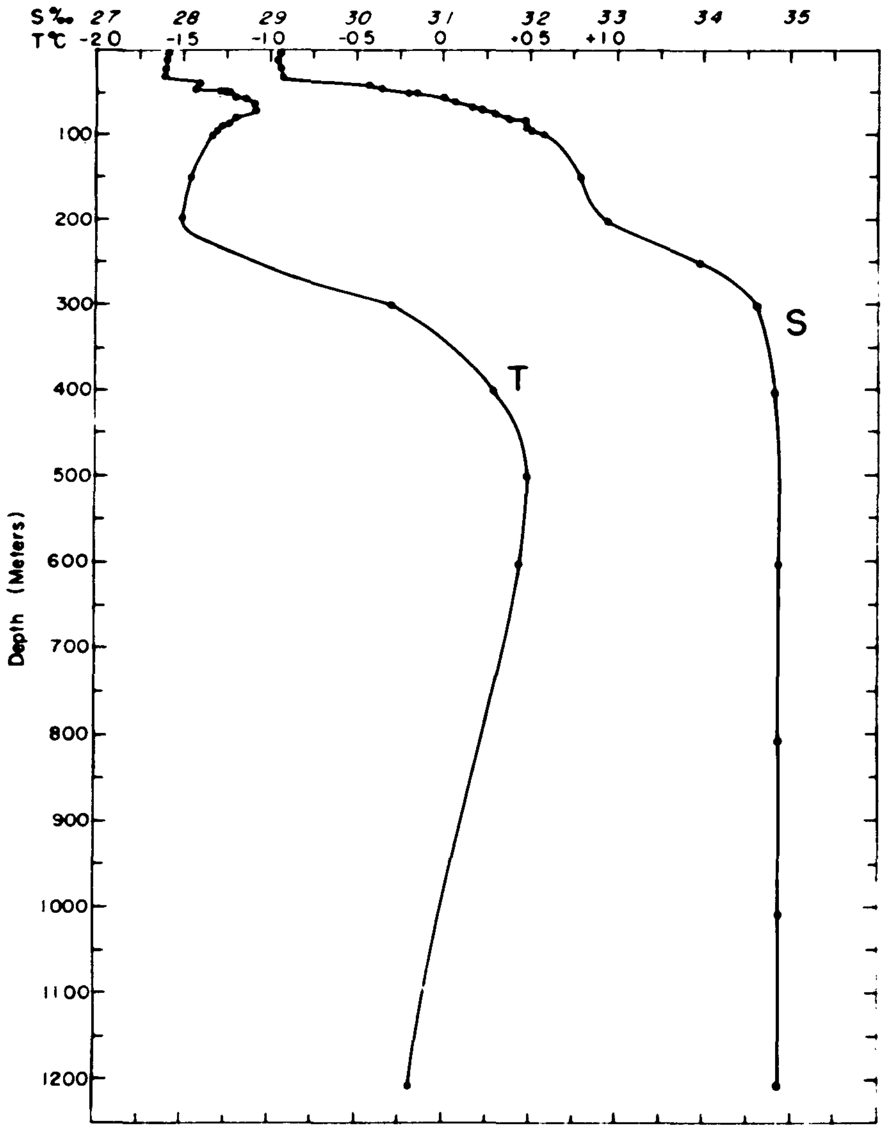

STATION NO. 17 + 18
S ‰ 27 28 29 30 31 32 33 34 35
T °C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
S


STATION NO. 19 + 20
S ‰ 27 28 29 30 31 32 33 34 35
T °C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
S

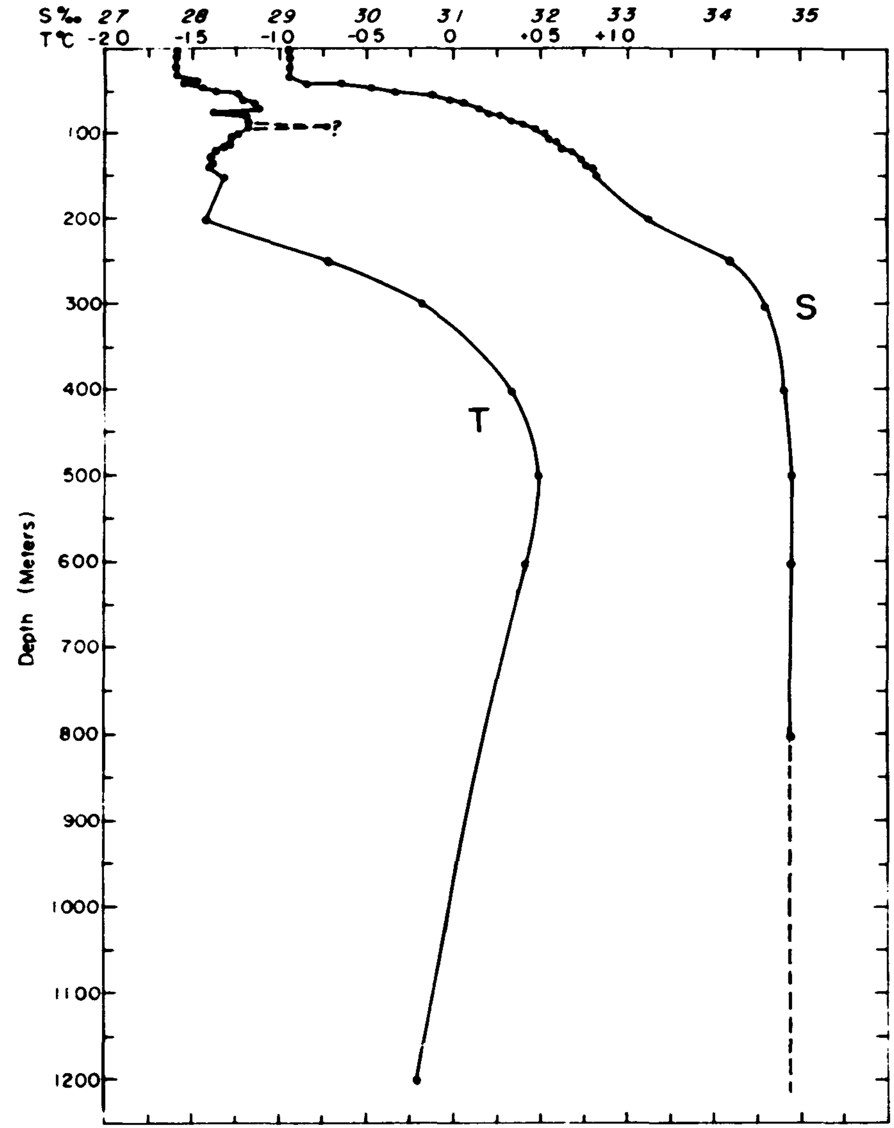

STATION NO. 21+22
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
S
T
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200

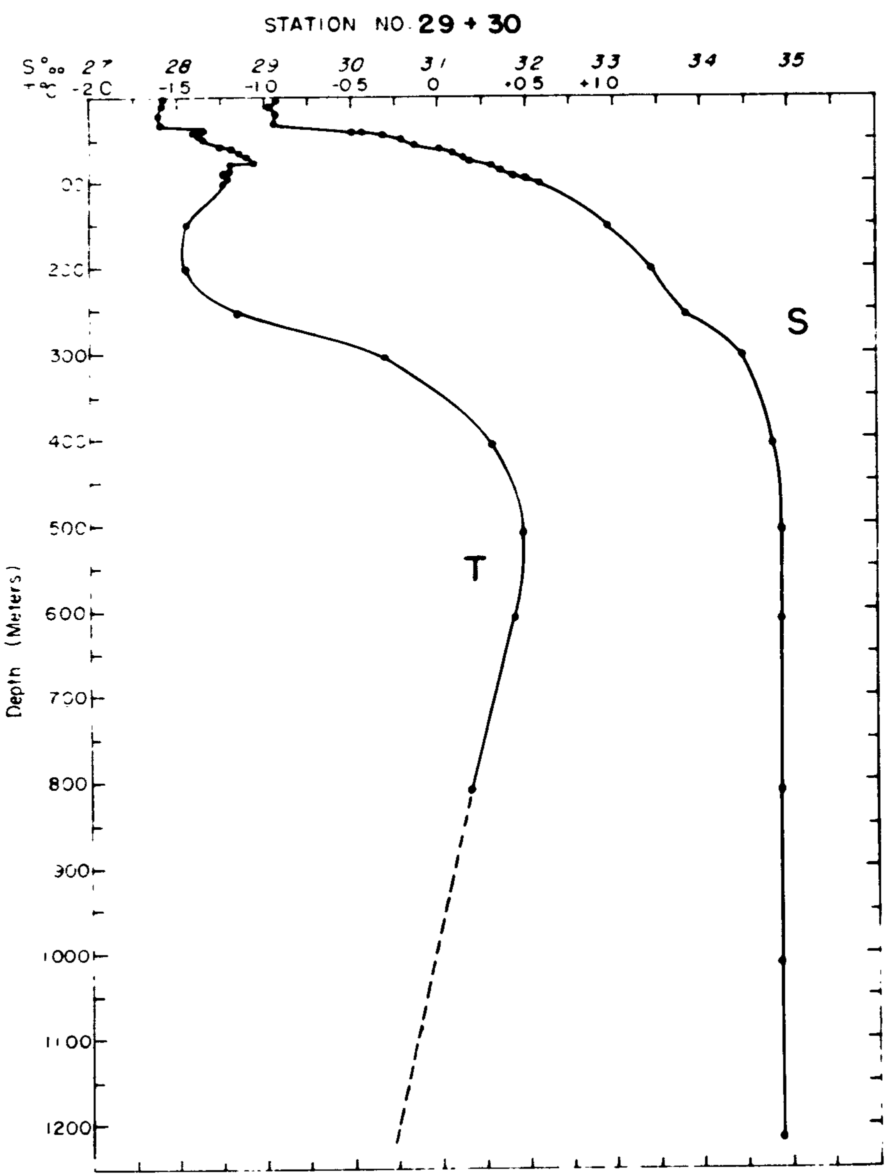

STATION NO. 23 + 24
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
S
T
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200

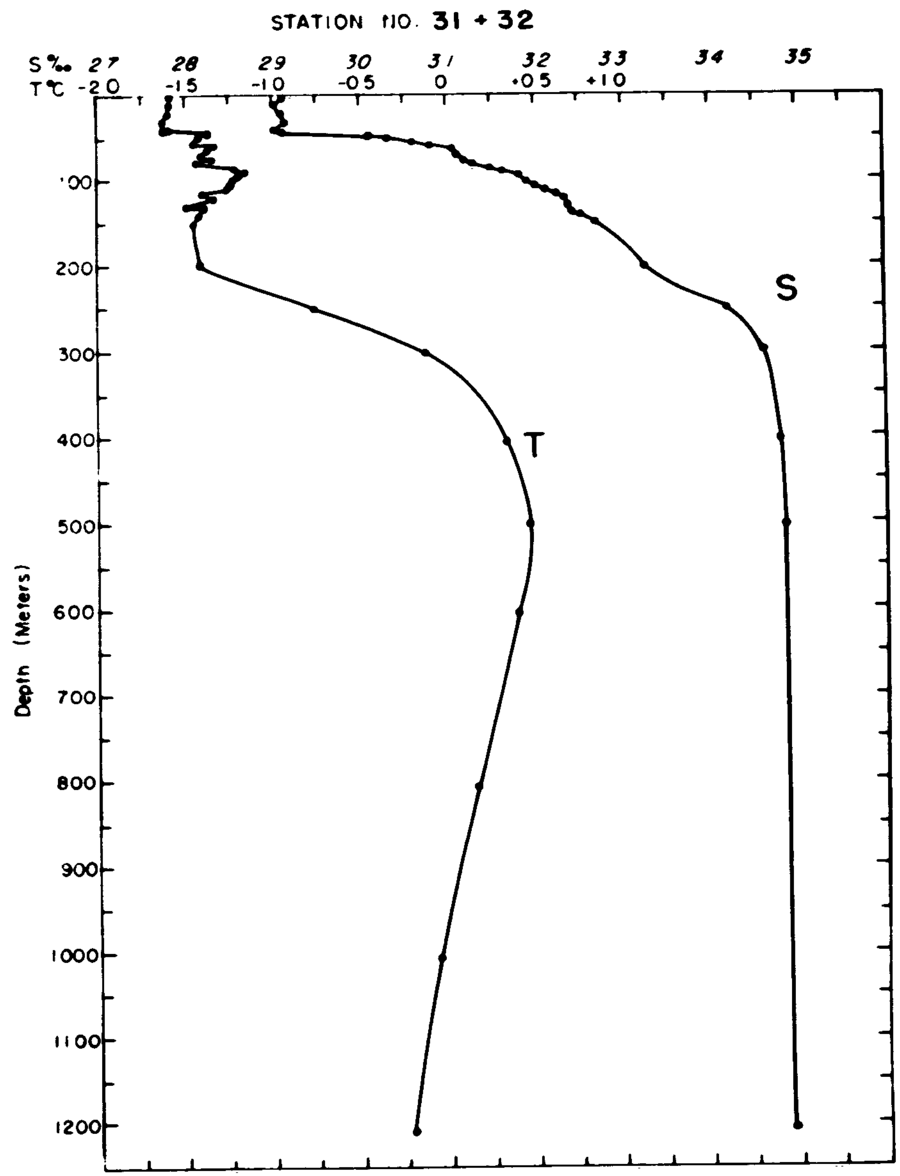
STATION NO. 25 + 26

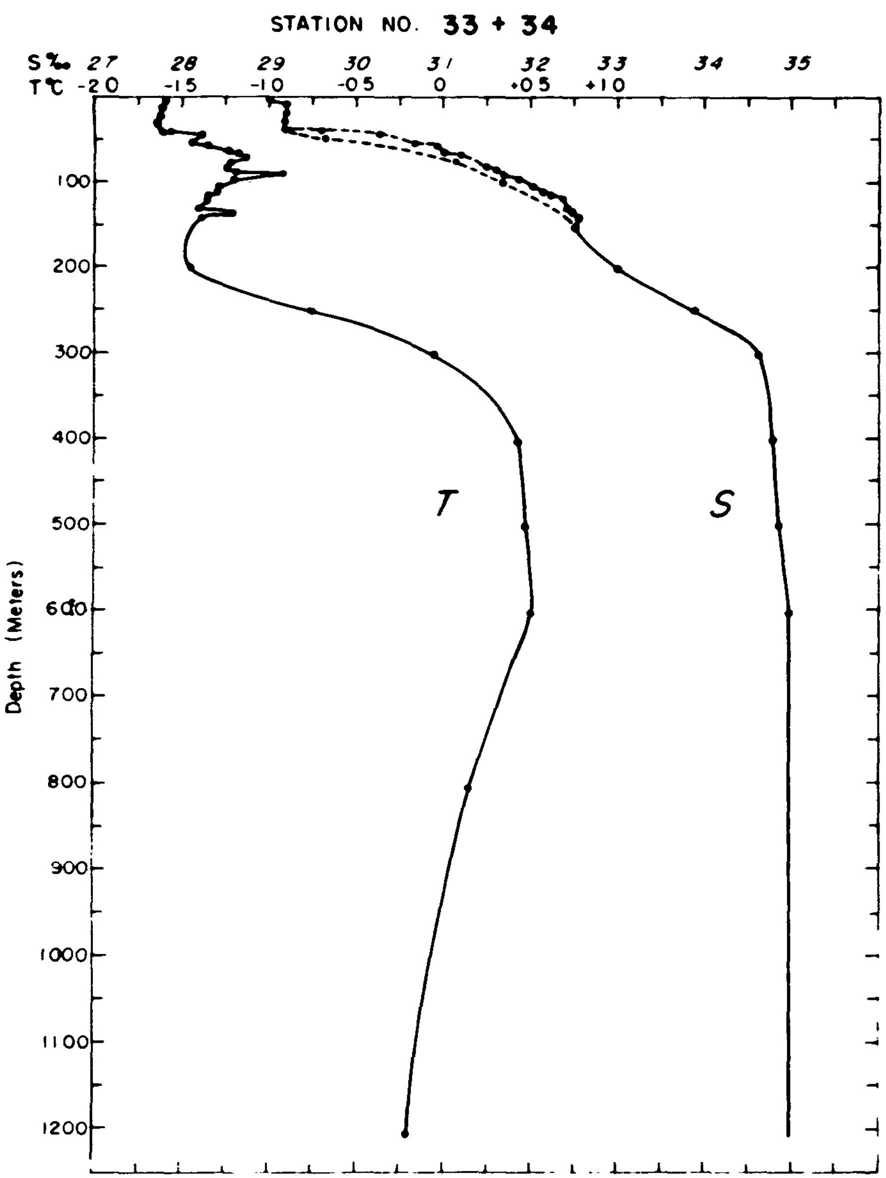


STATION NO. 27 + 28

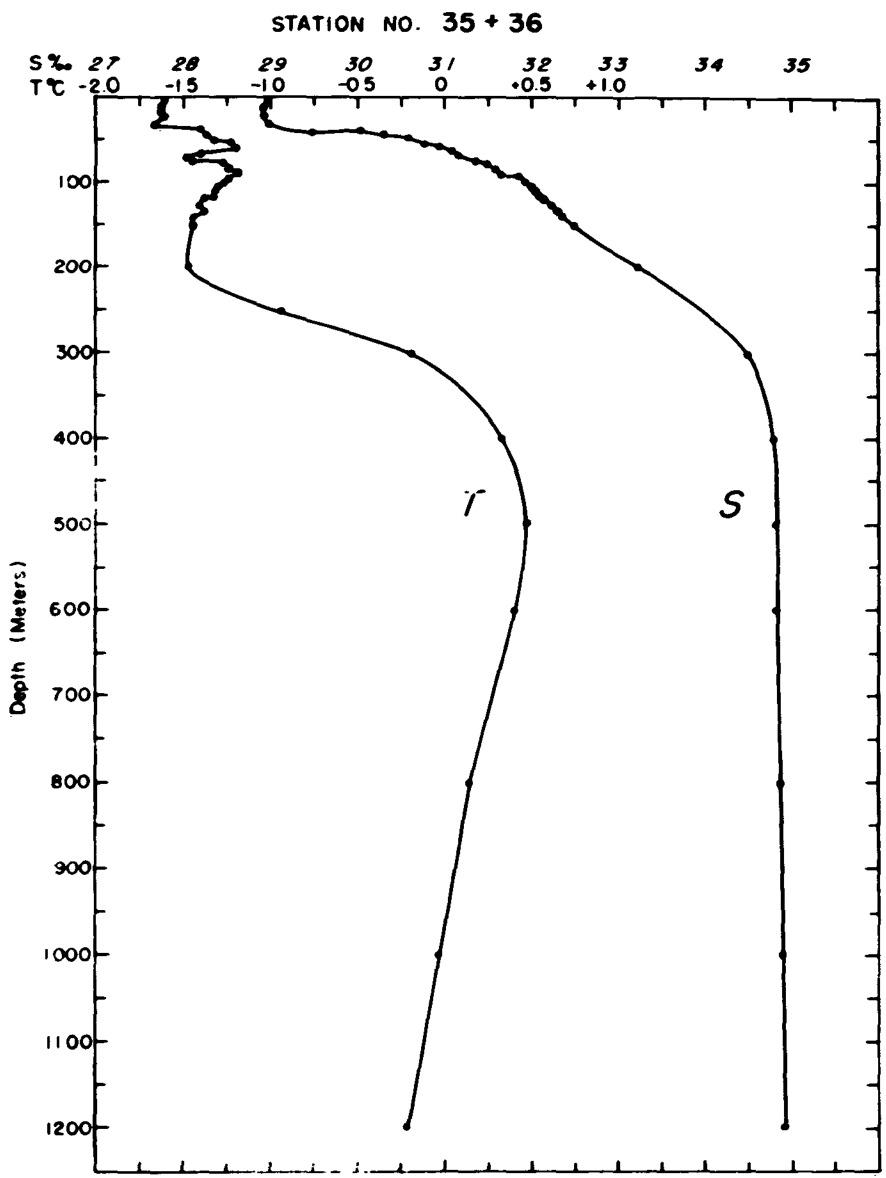



STATION NO. 29 + 30
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
S
T
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200


STATION NO. 31 + 32
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
S
T
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200

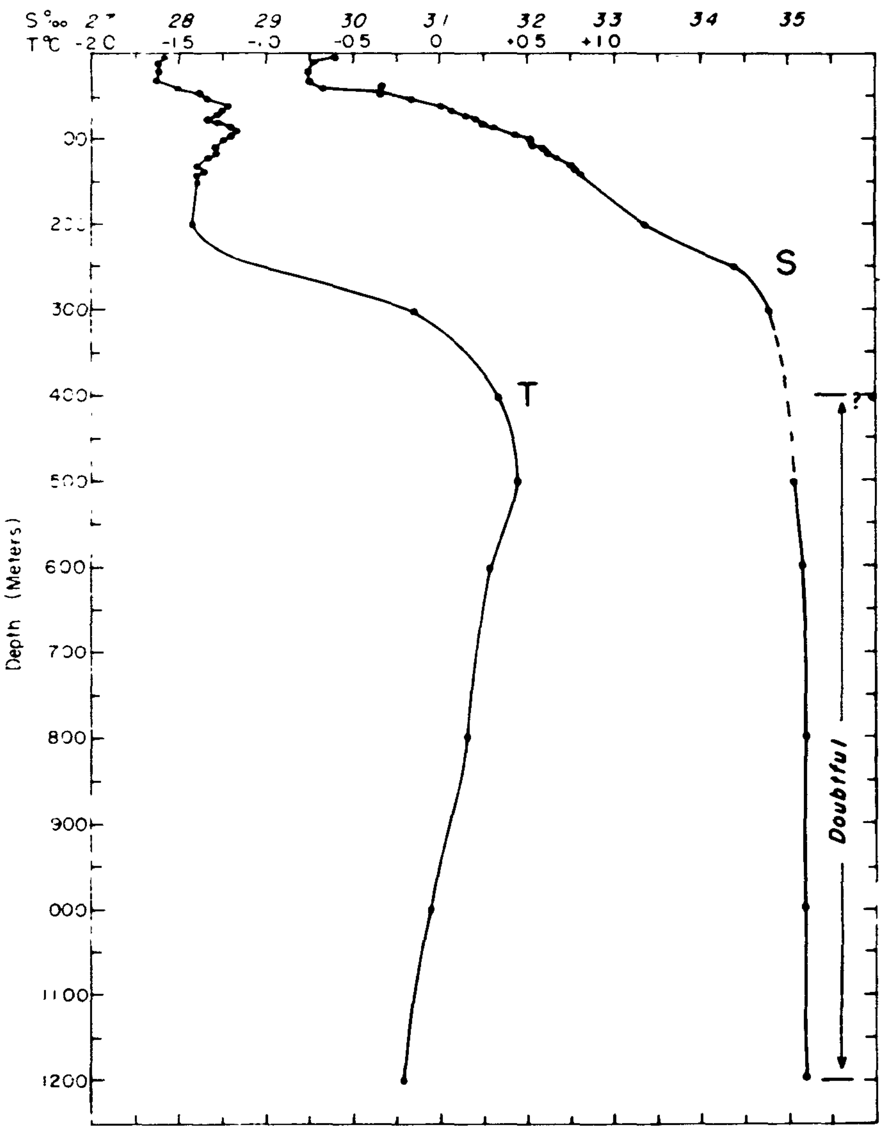


STATION NO. 33 + 34
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
S

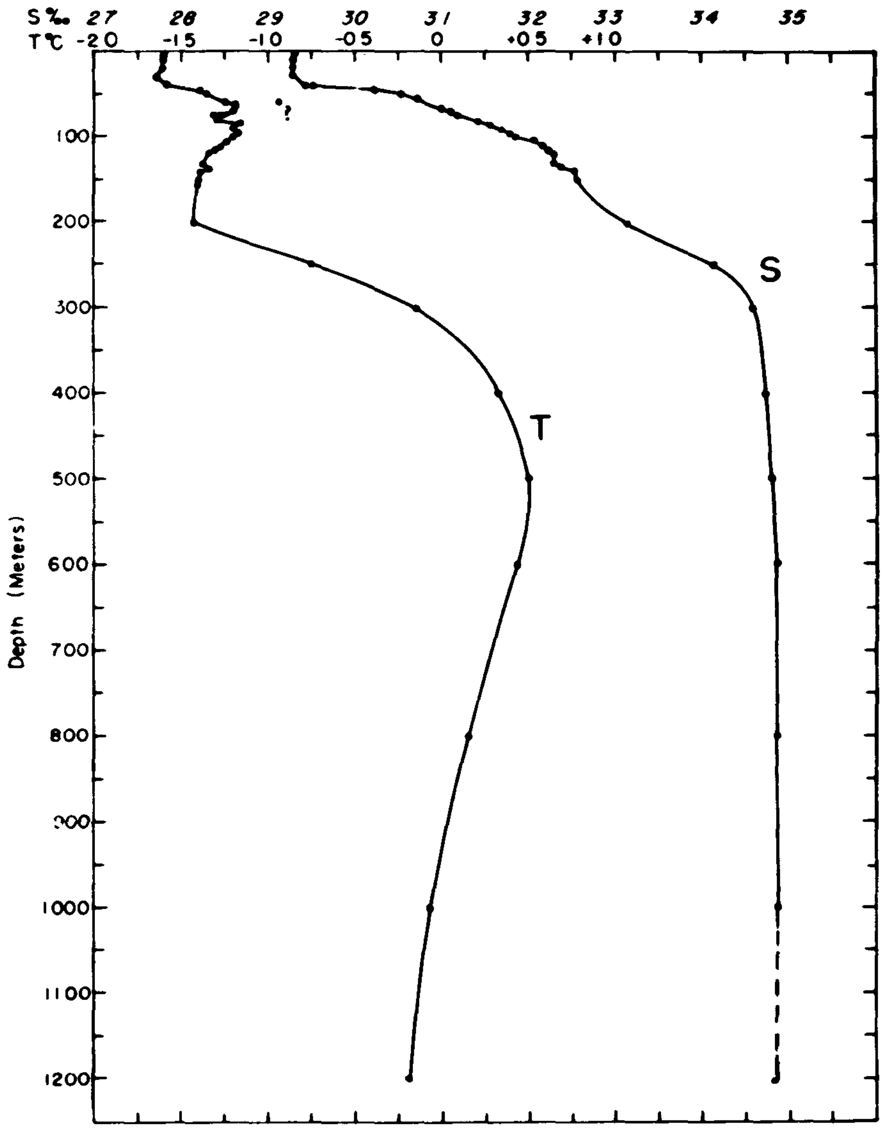


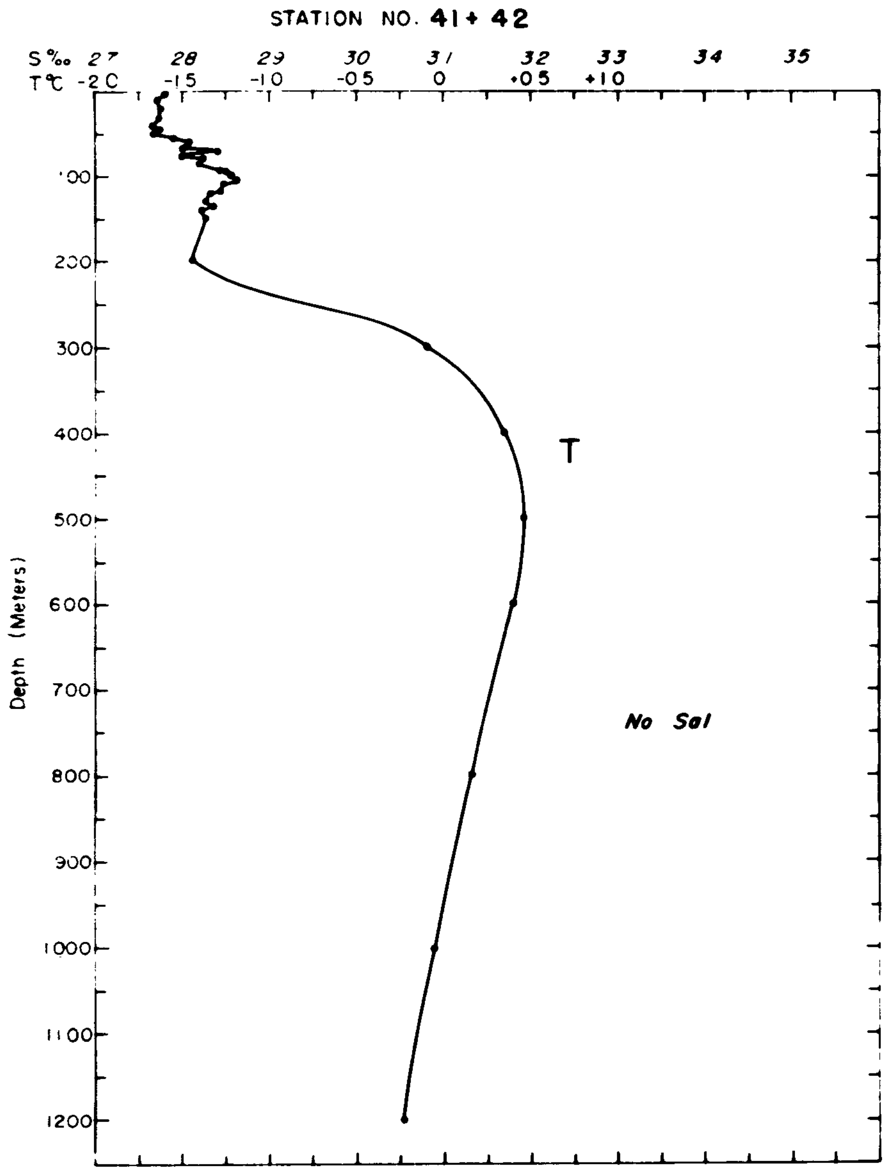
STATION NO. 35 + 36
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
S

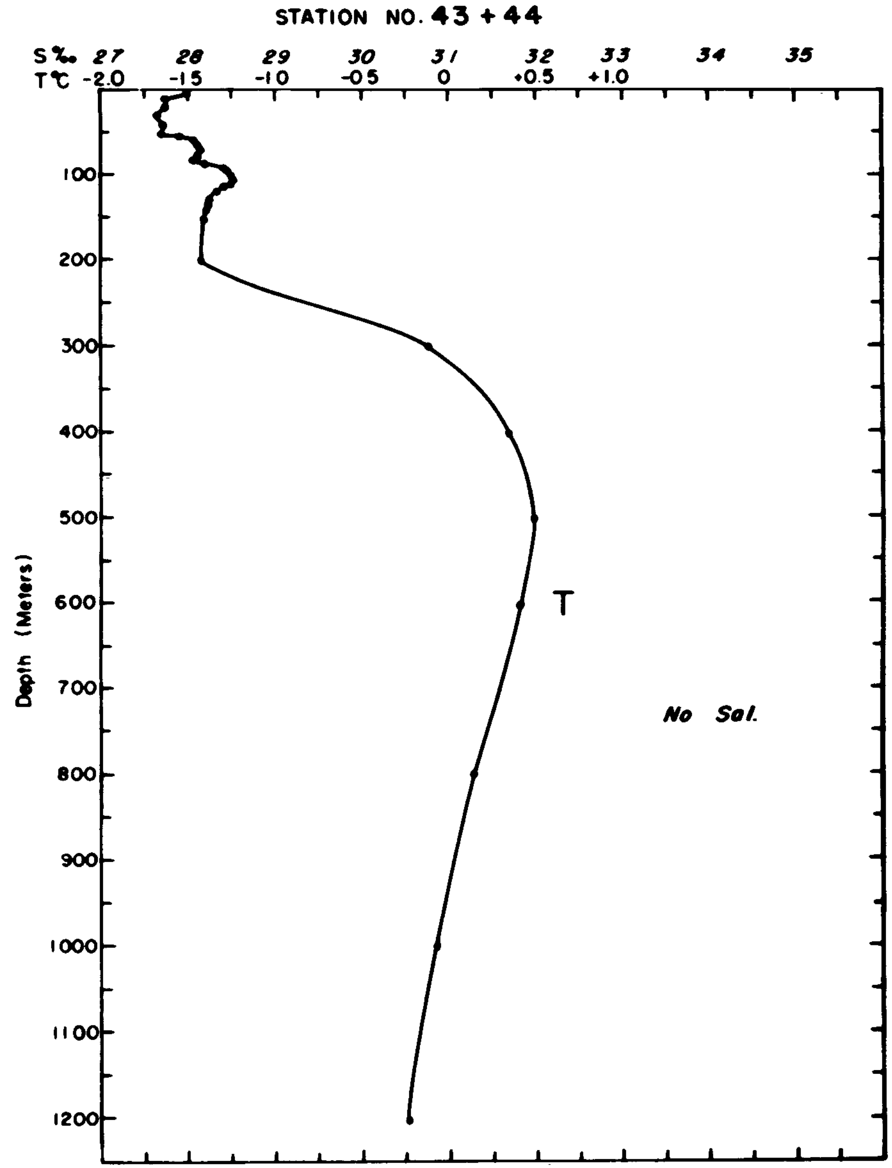
STATION NO 37 + 38



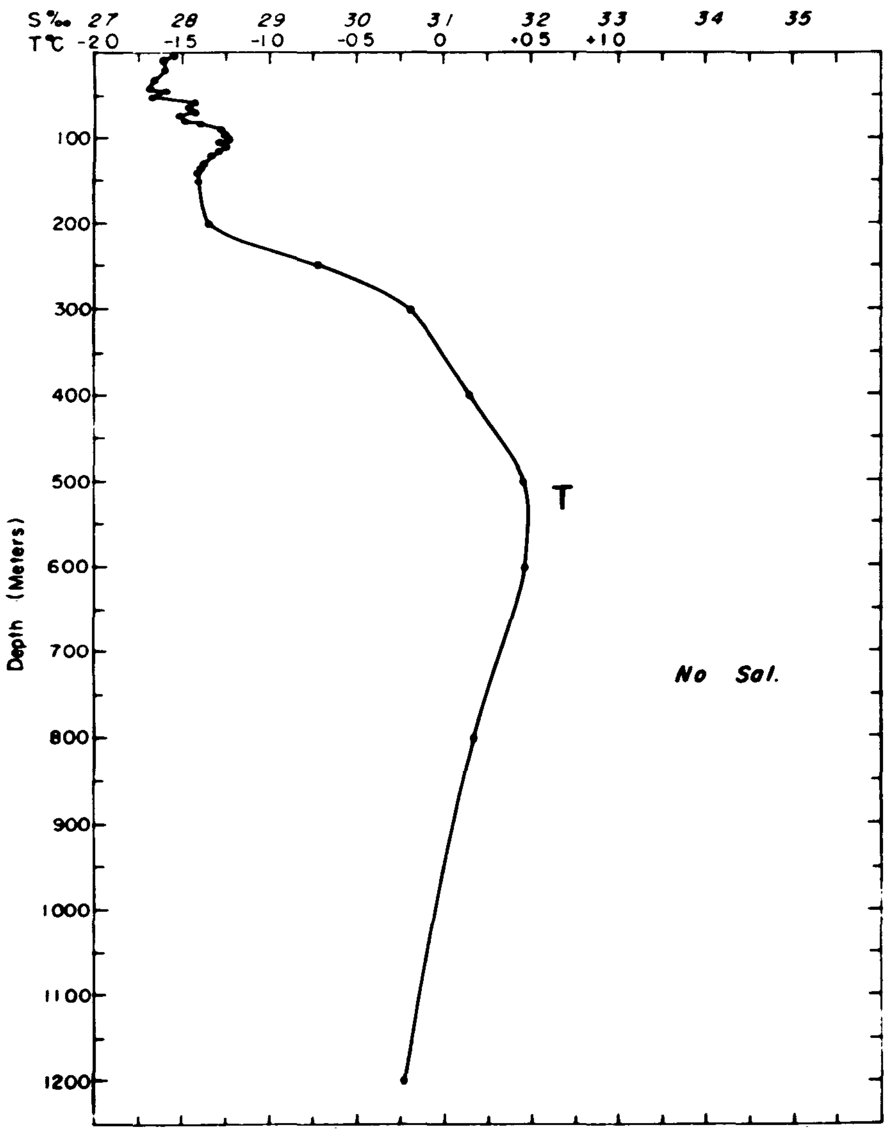
STATION NO. 39+40



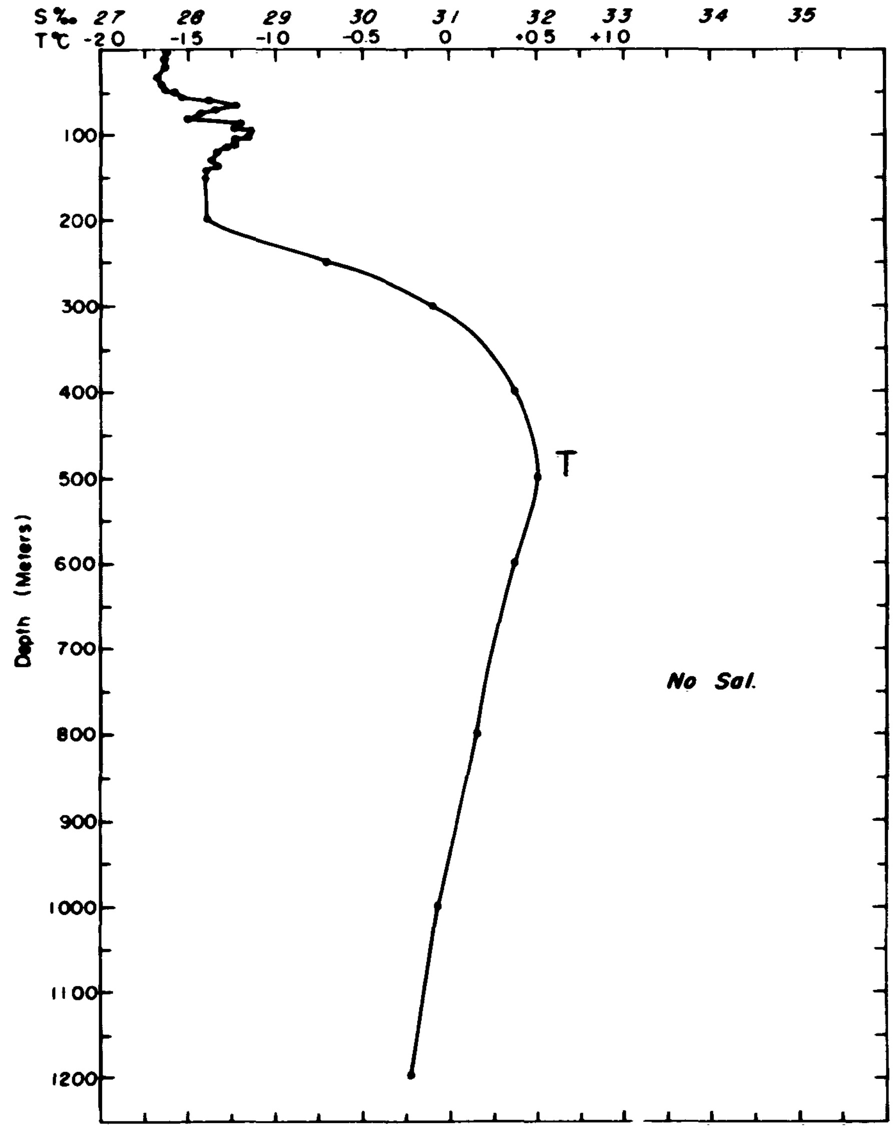

STATION NO. 41 + 42
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
No Sal

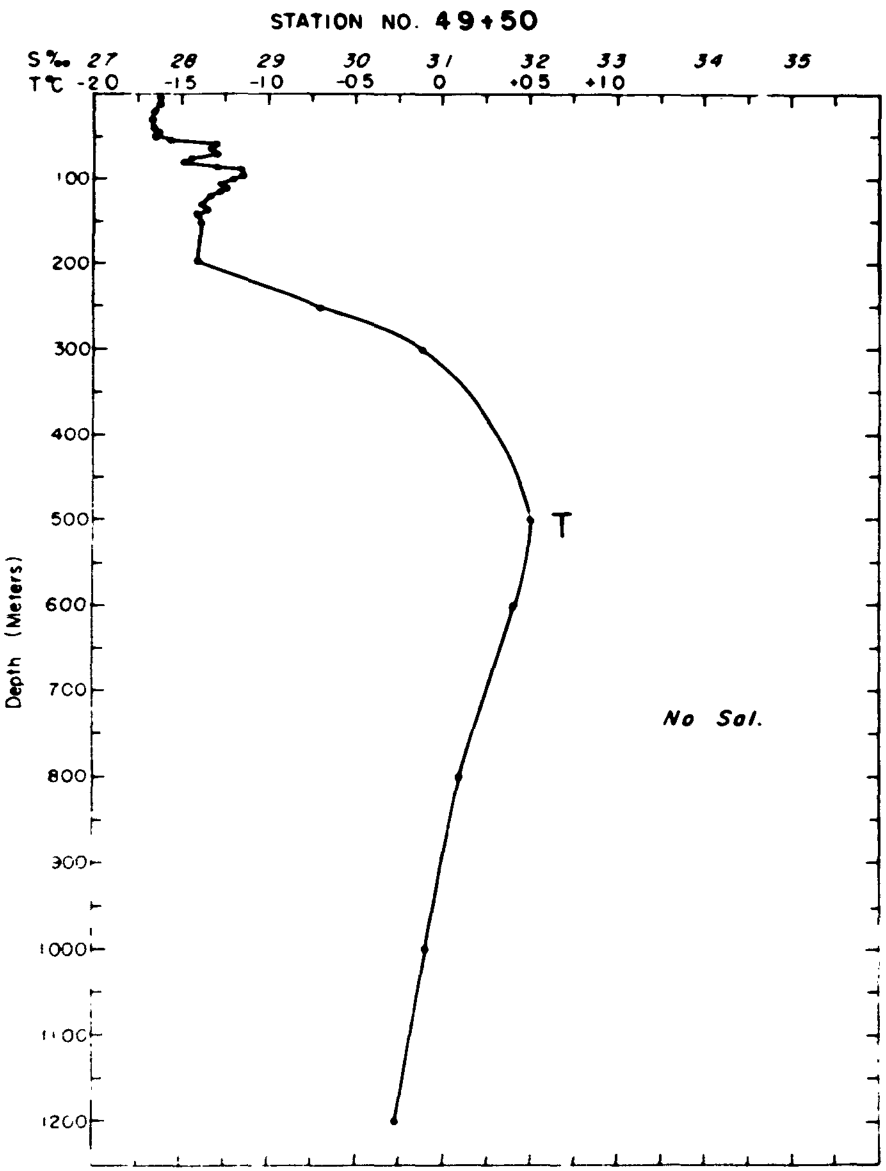

STATION NO. 43 + 44
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
No Sal.

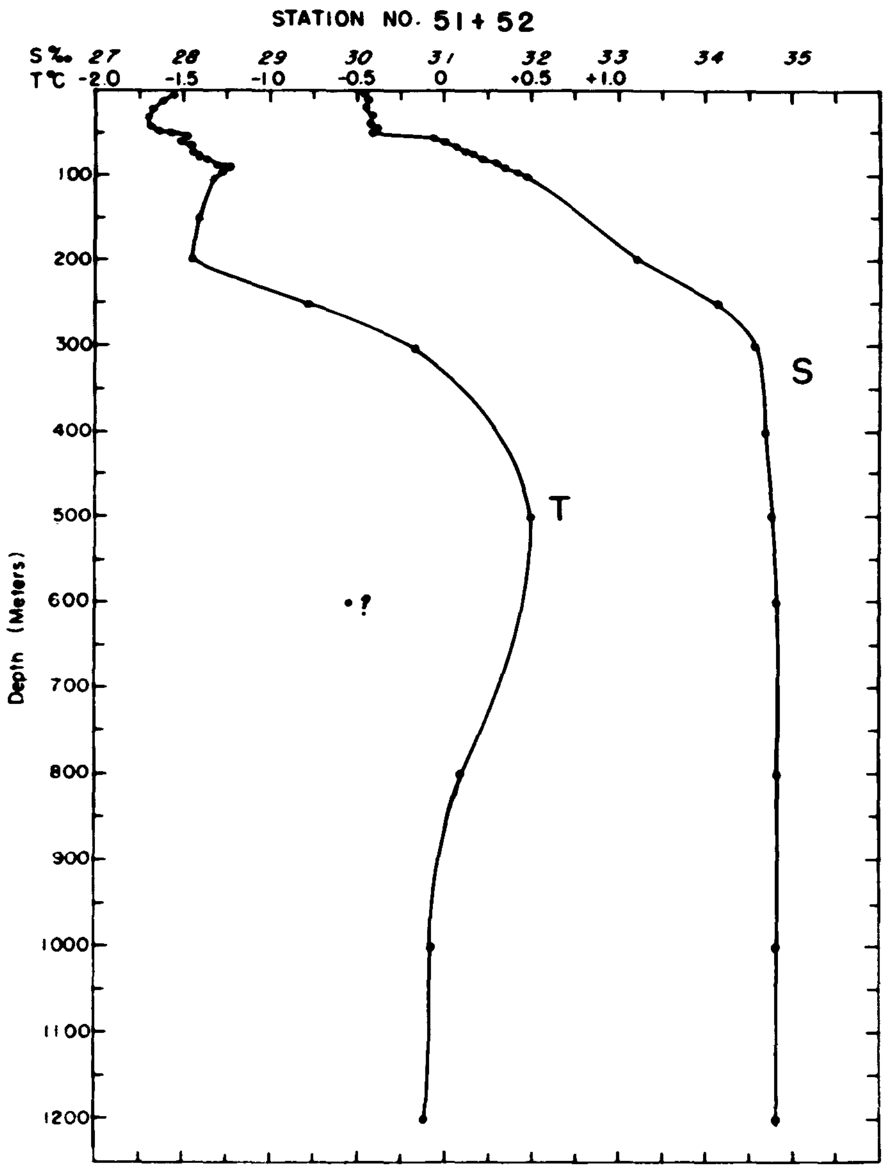
STATION NO. 45 + 46



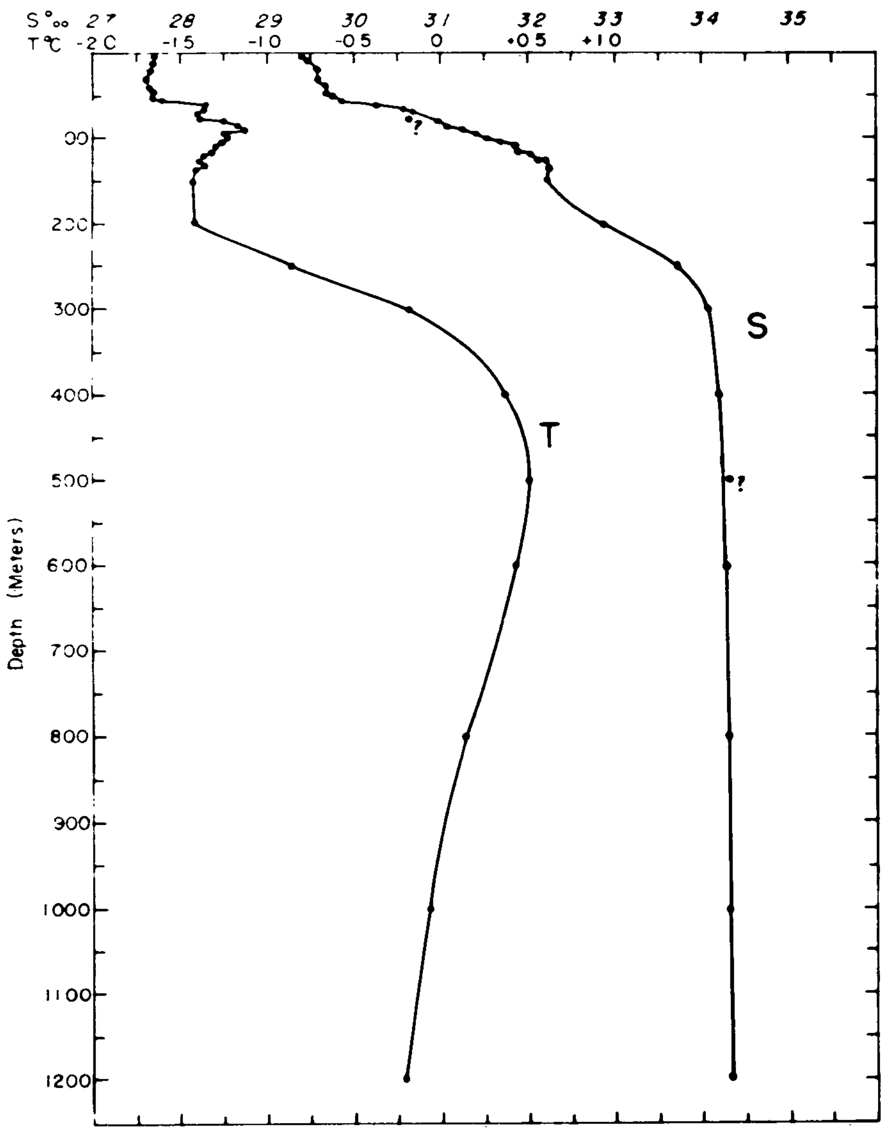
STATION NO. 47 + 48



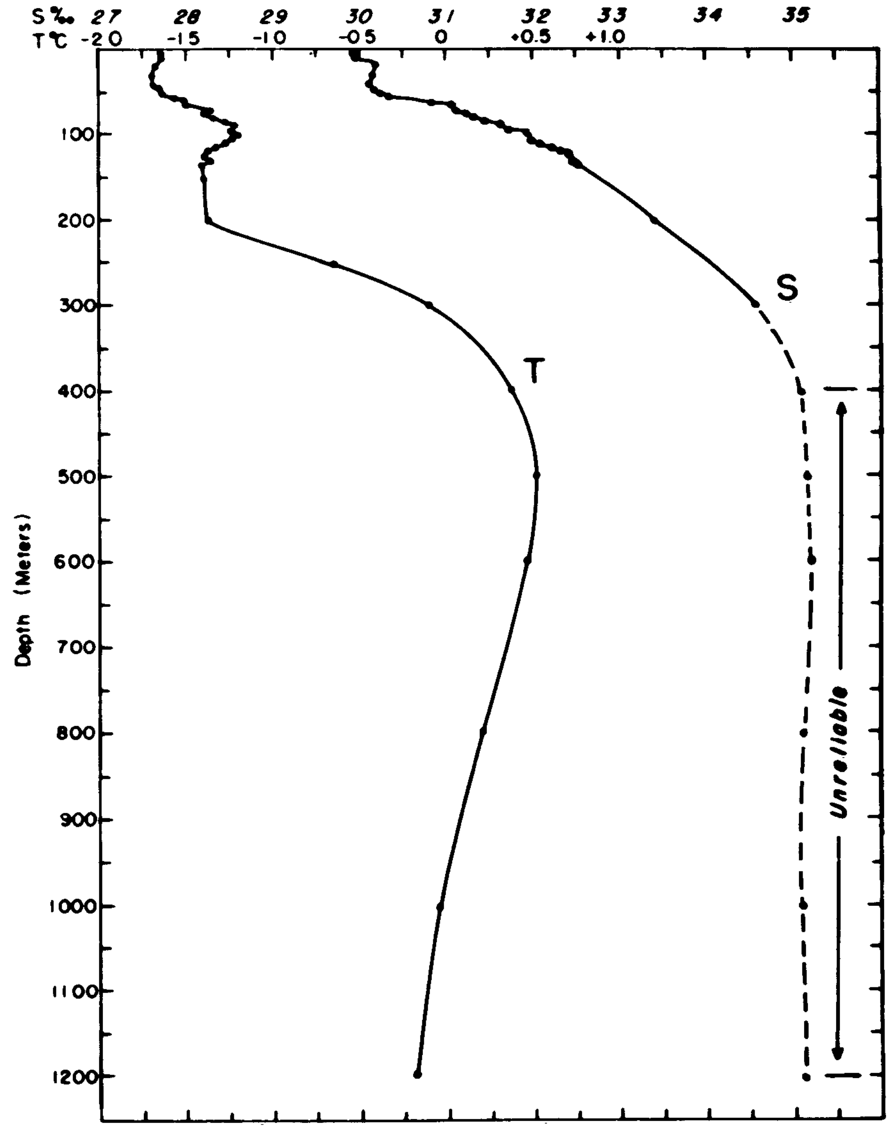

STATION NO. 49+50
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
No Sal.

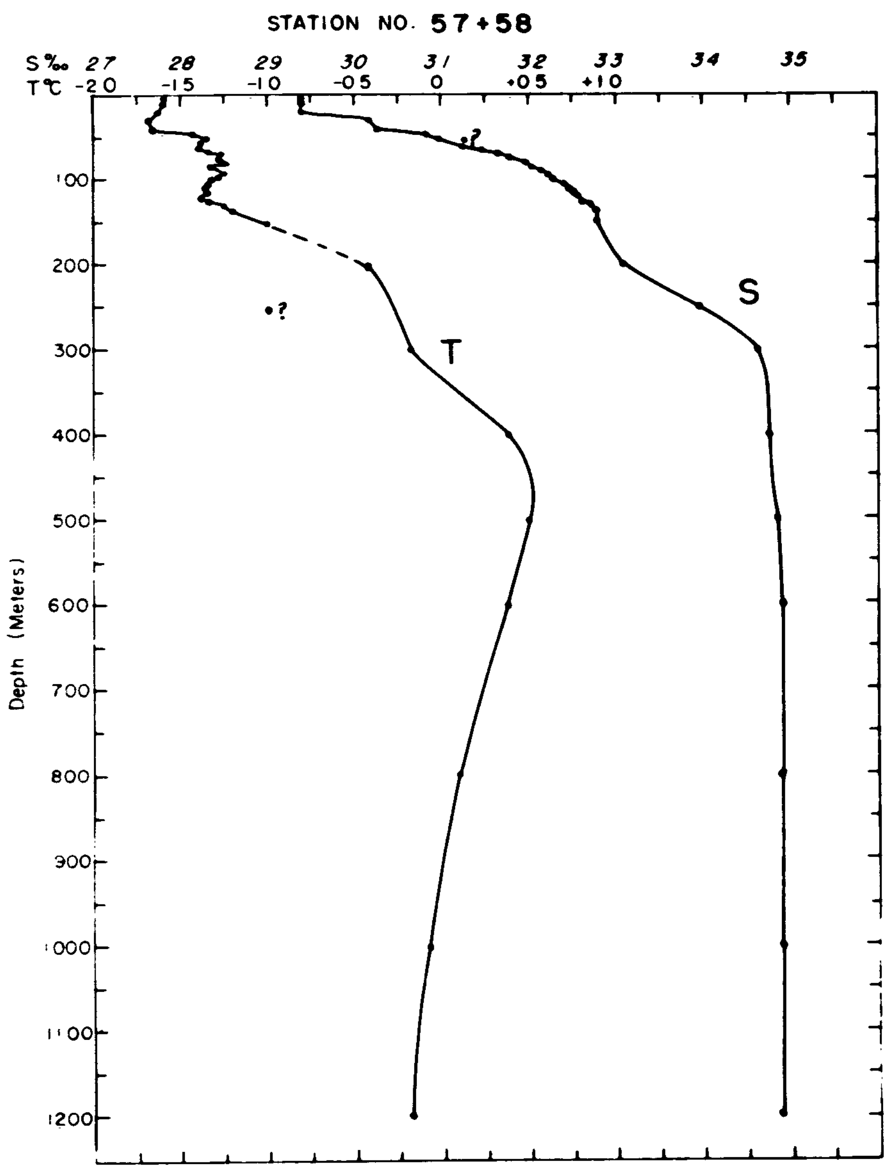

STATION NO. 51+52
S‰ 27 28 29 30 31 32 33 34 35
T°C -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
T
S
?

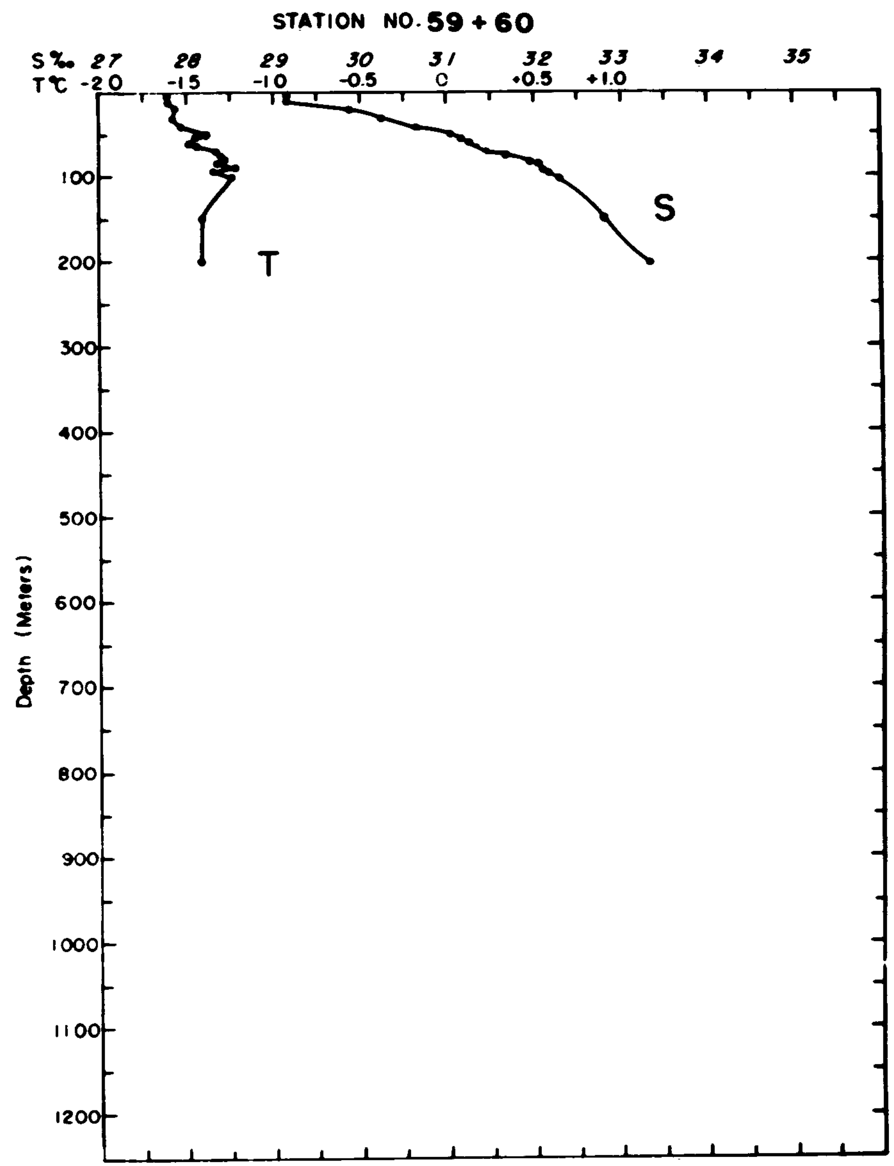
STATION NO 53+54



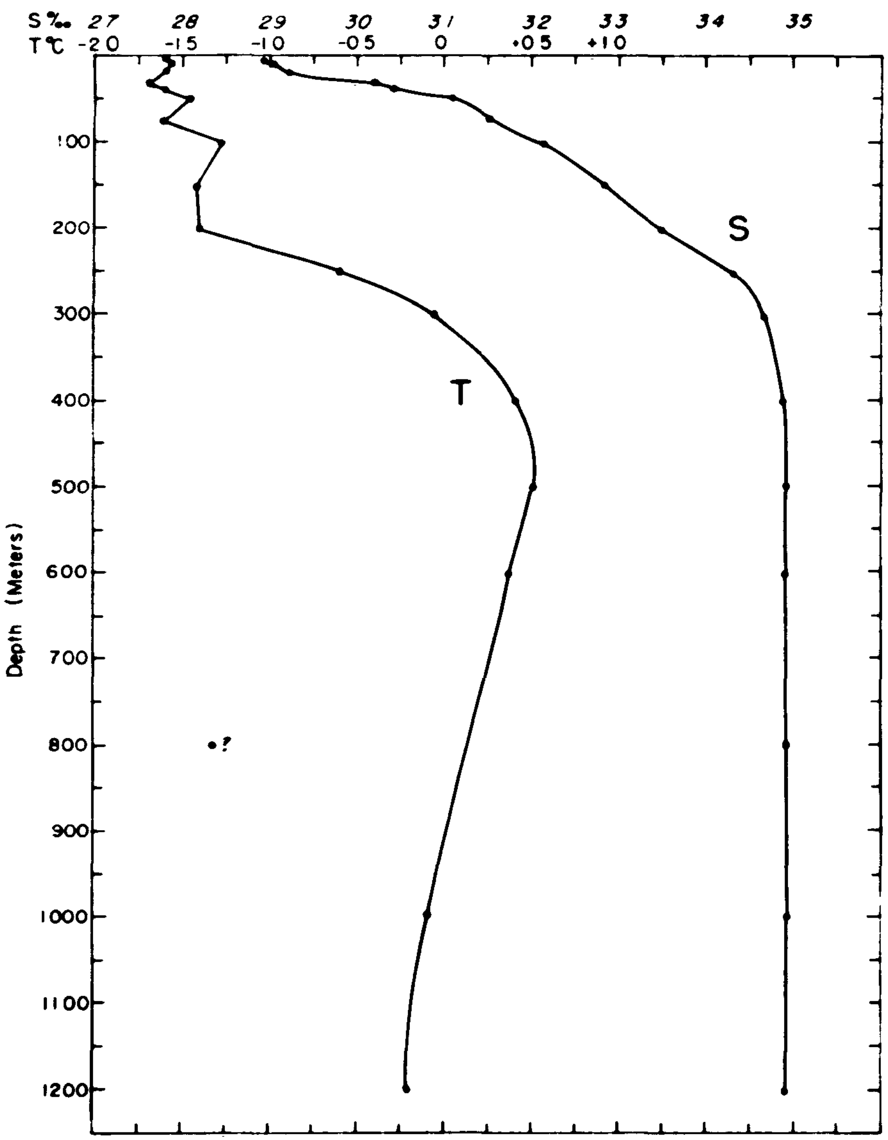
STATION NO. 55+56



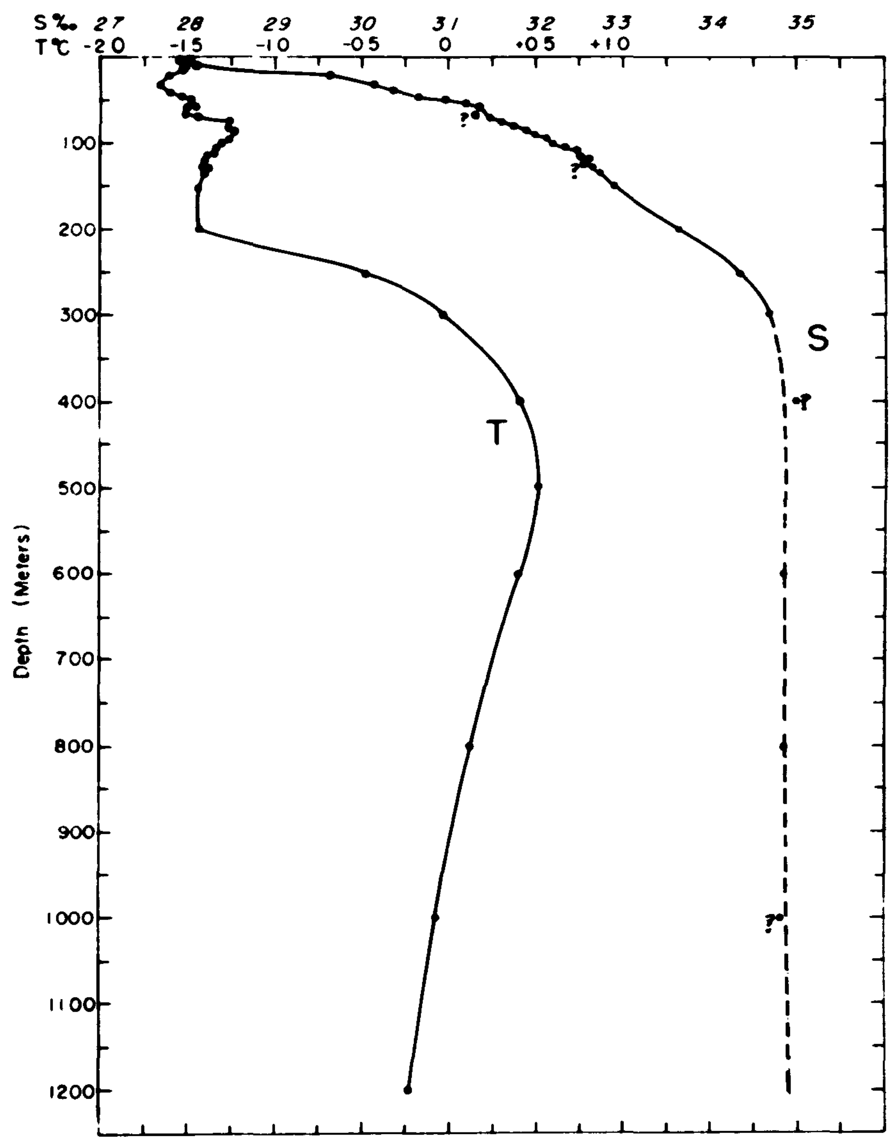

STATION NO. 57+58
S‰ 27 28 29 30 31 32 33 34 35
T℃ -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
S
T
?
?


STATION NO. 59+60
S‰ 27 28 29 30 31 32 33 34 35
T℃ -2.0 -1.5 -1.0 -0.5 0 +0.5 +1.0
Depth (Meters)
100 200 300 400 500 600 700 800 900 1000 1100 1200
S
T

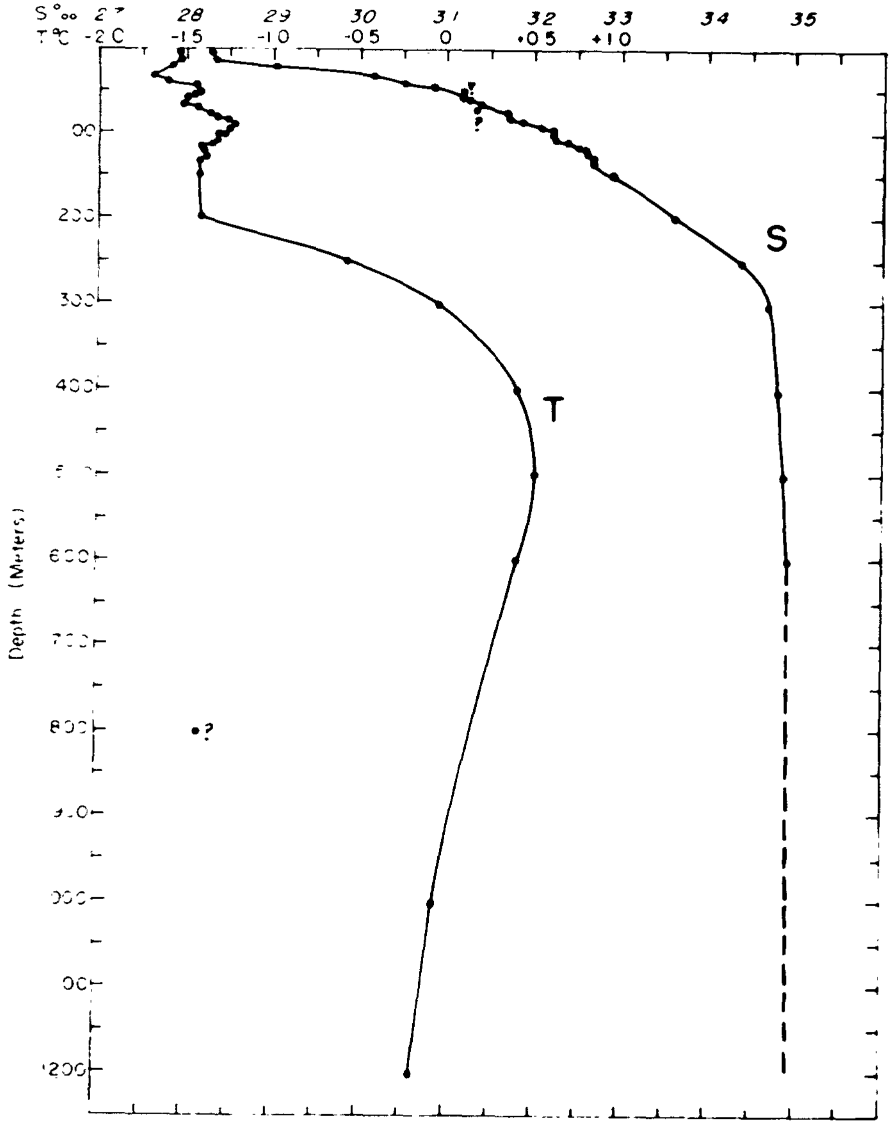
STATION NO. 61



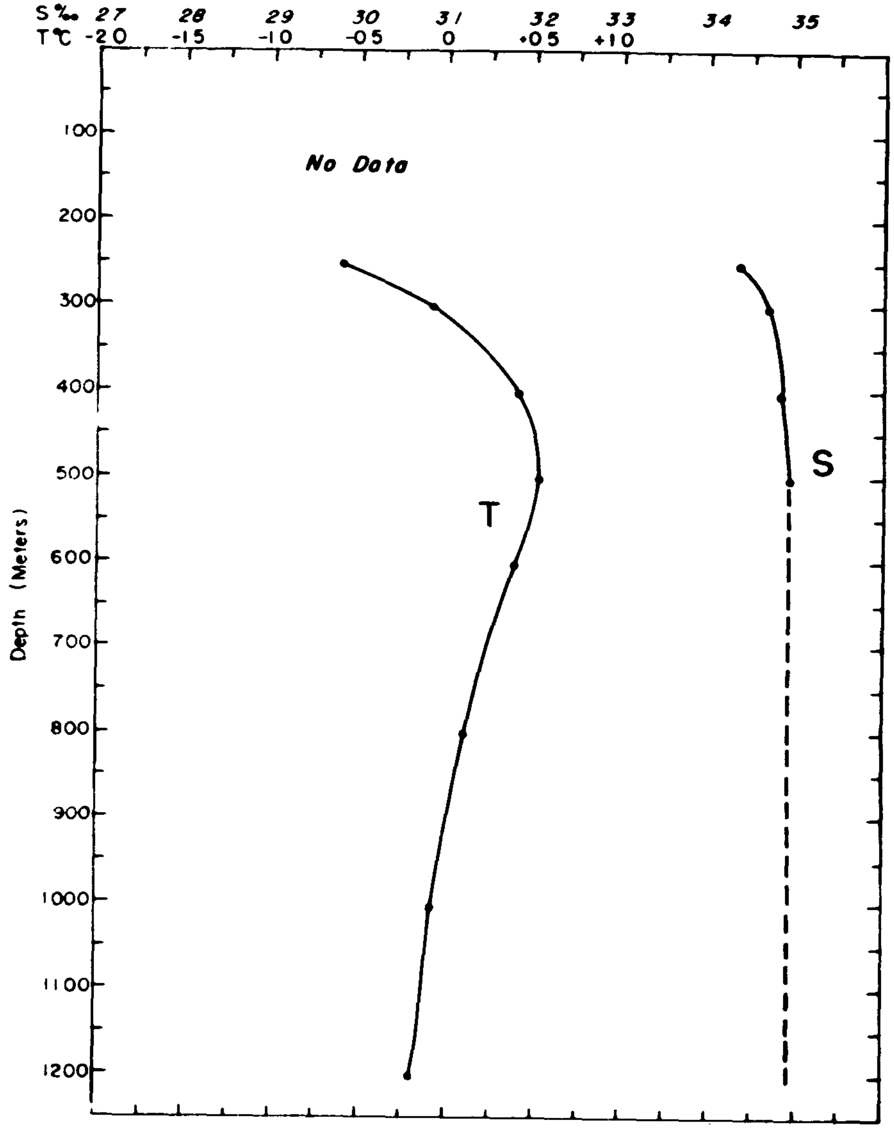
STATION NO. 62 + 63



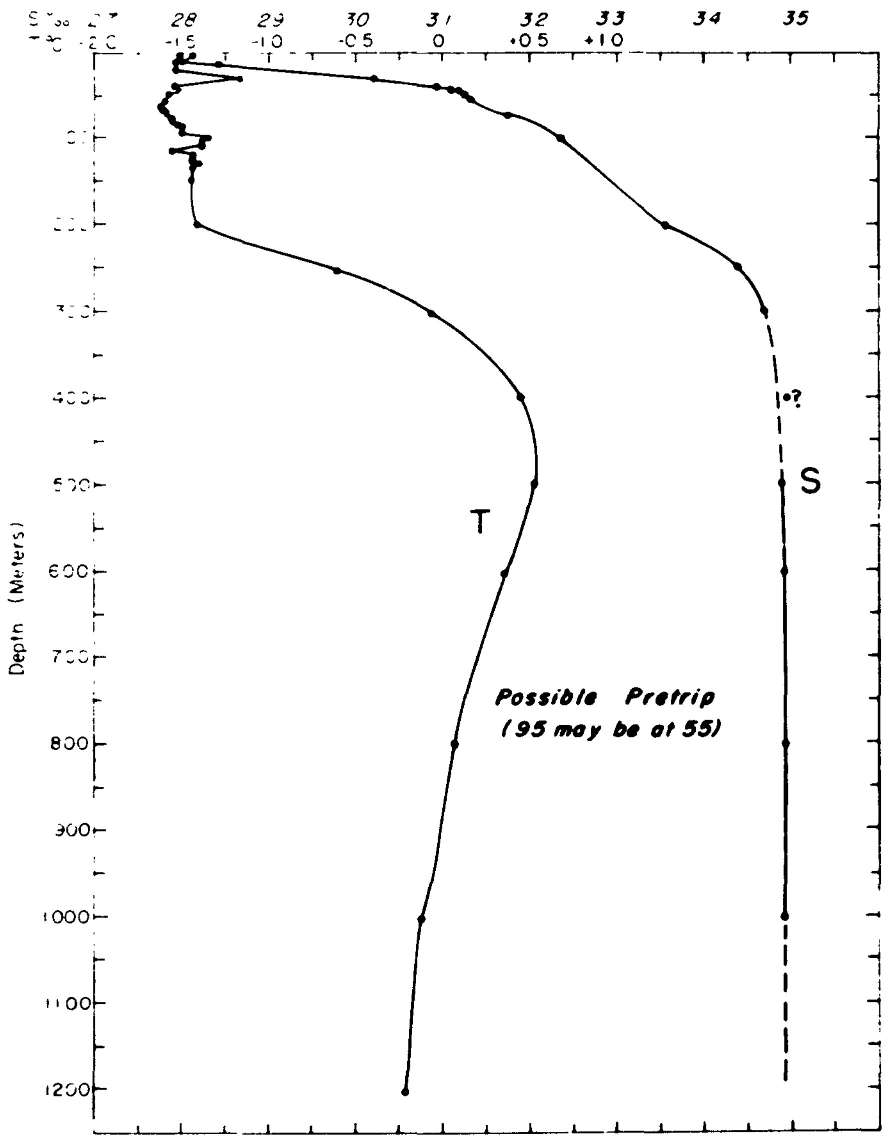
STATION NO 64 + 65



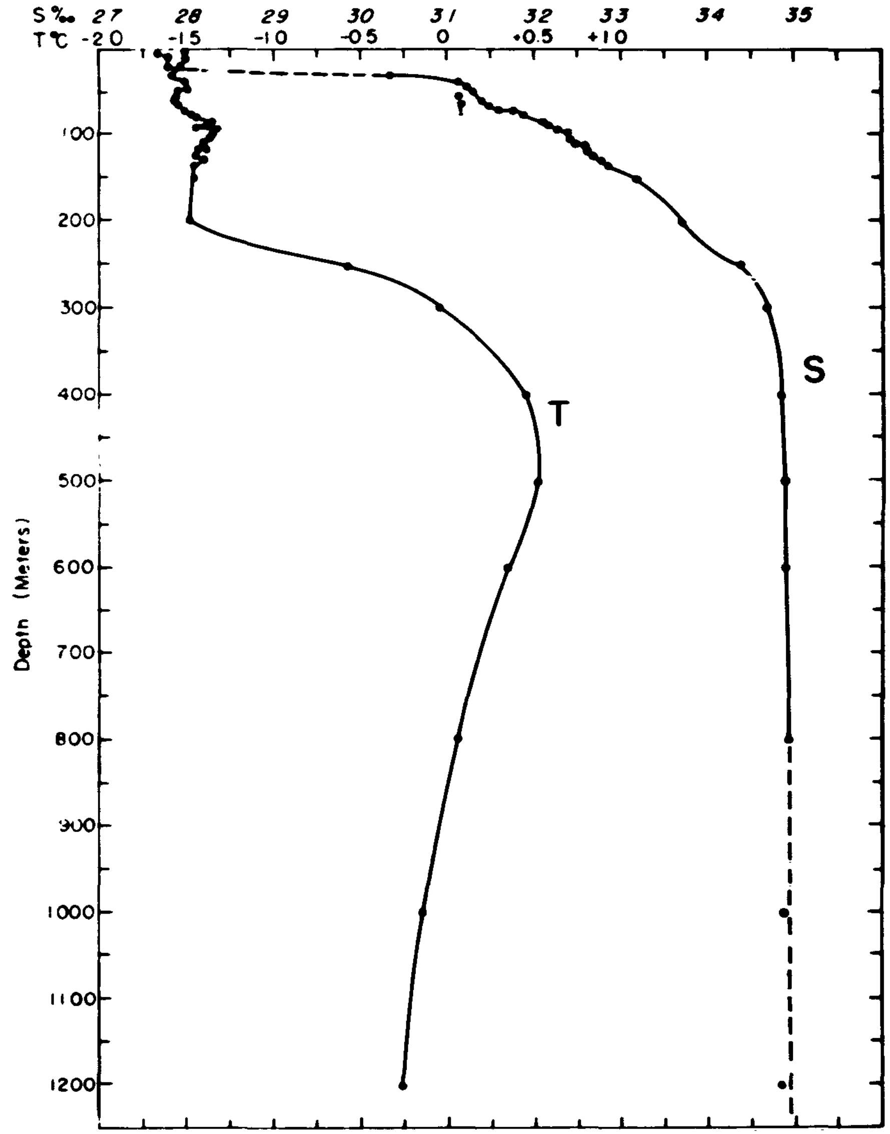
STATION NO. 66



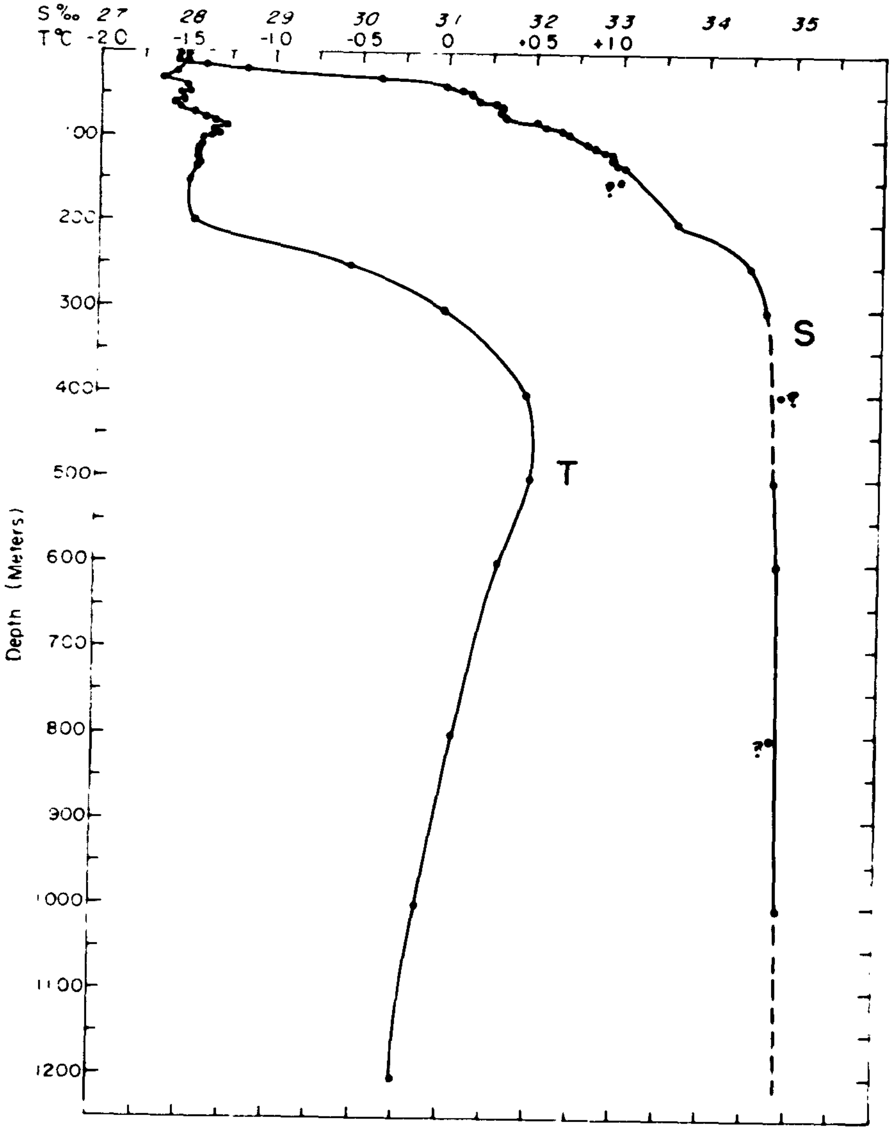
STATION NO 67 + 68



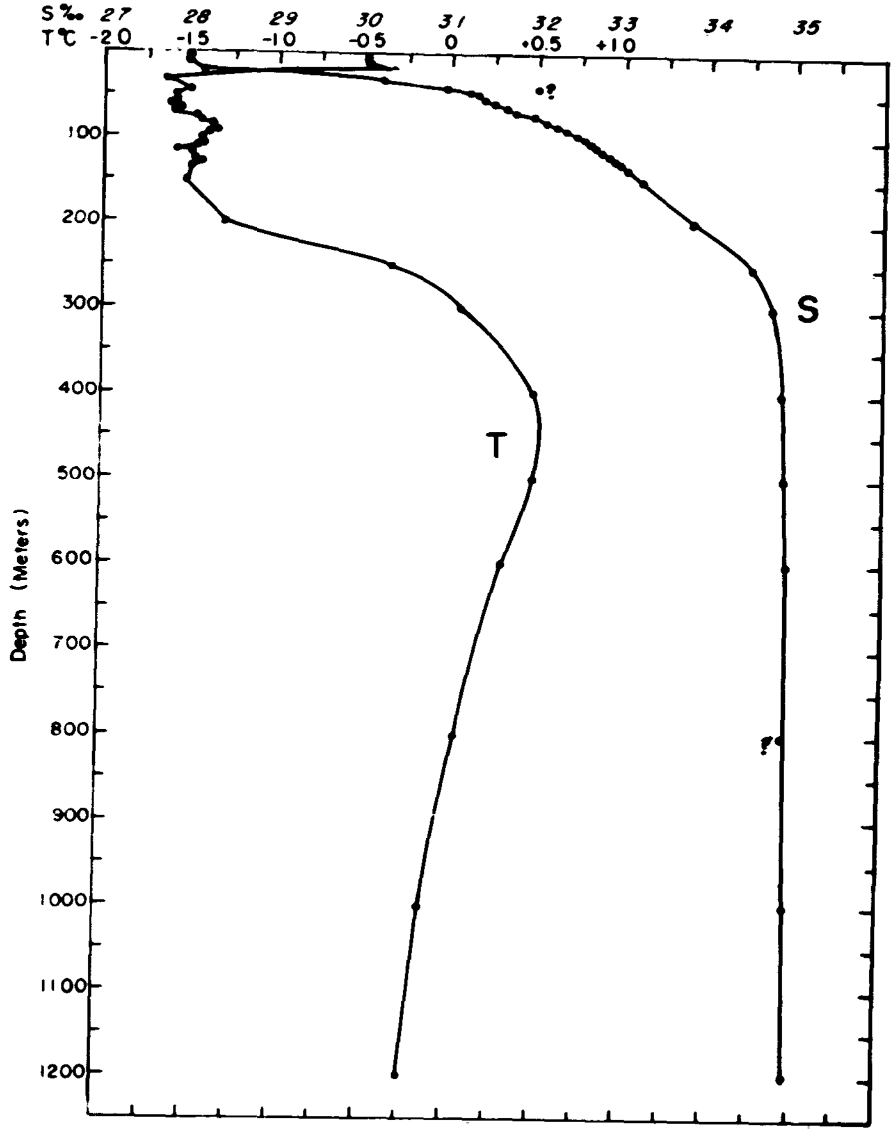
STATION NO. 69 + 70



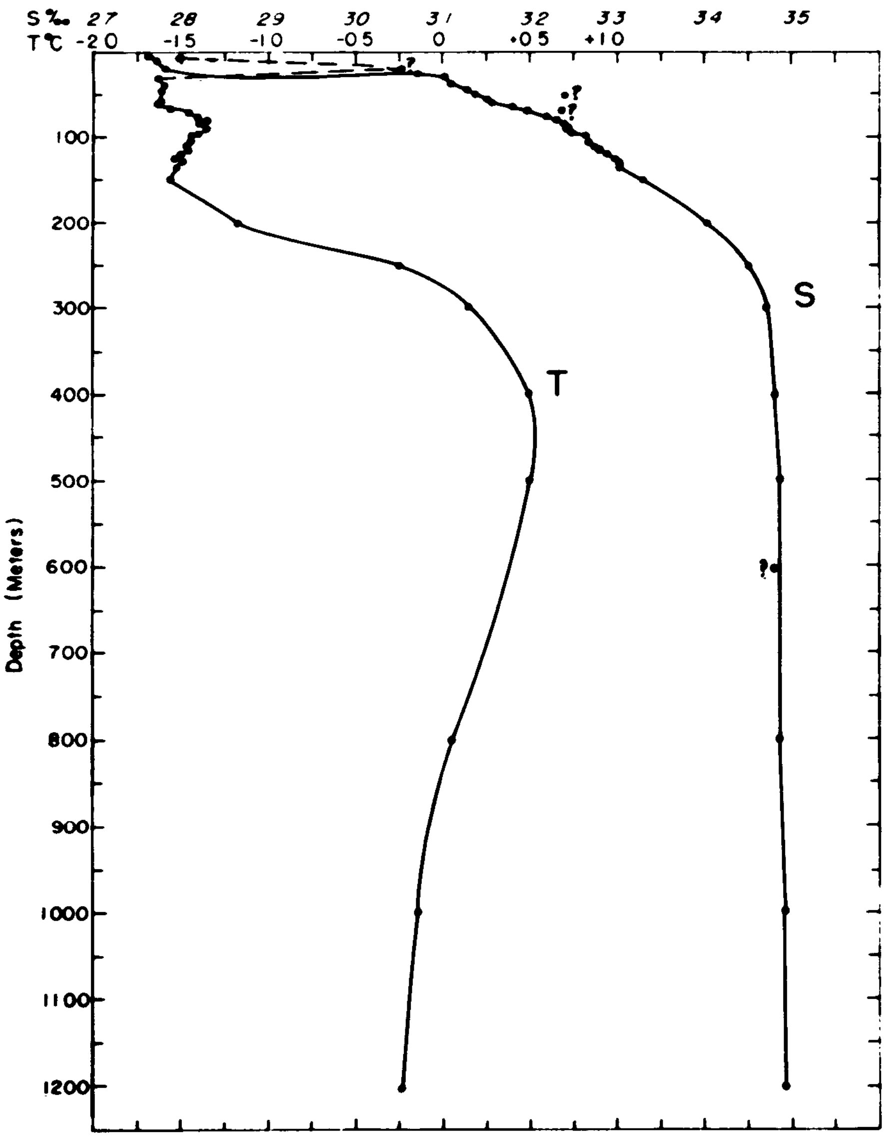
STATION NO. 71 + 72



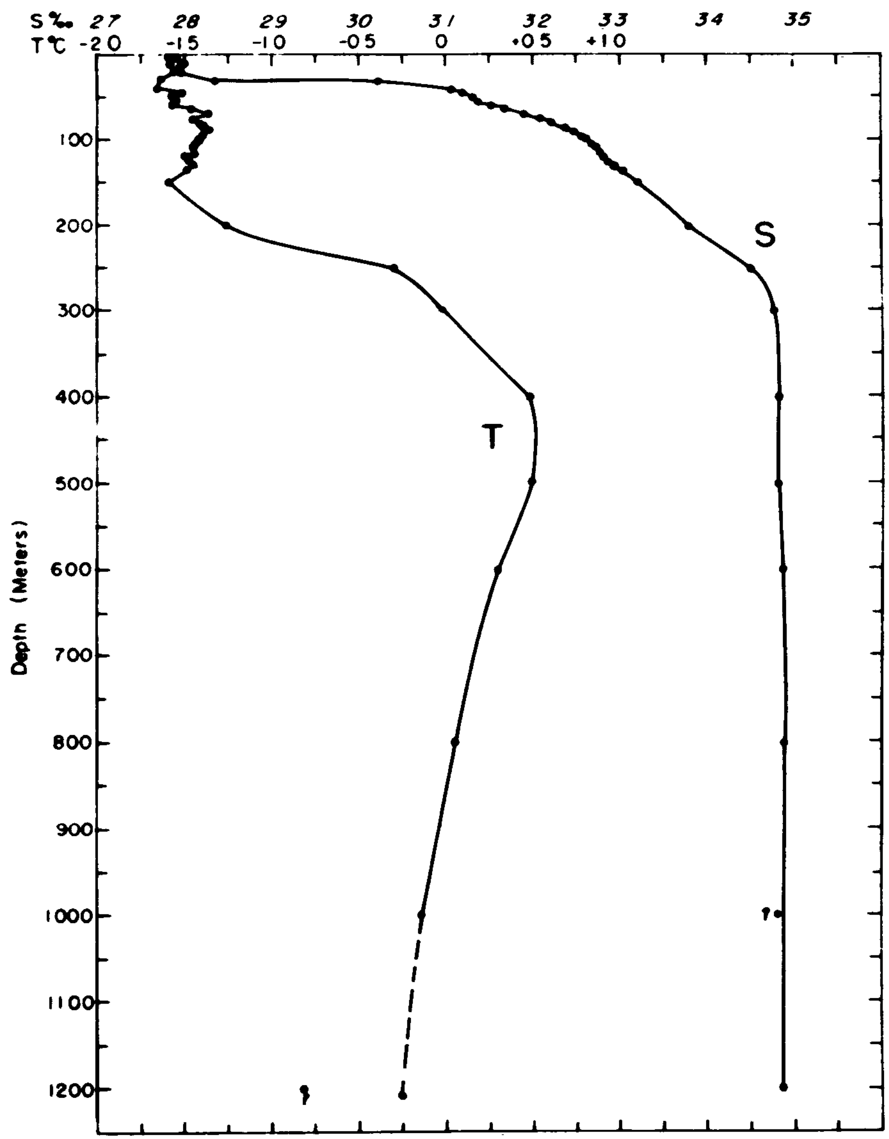
STATION NO. 73 + 74



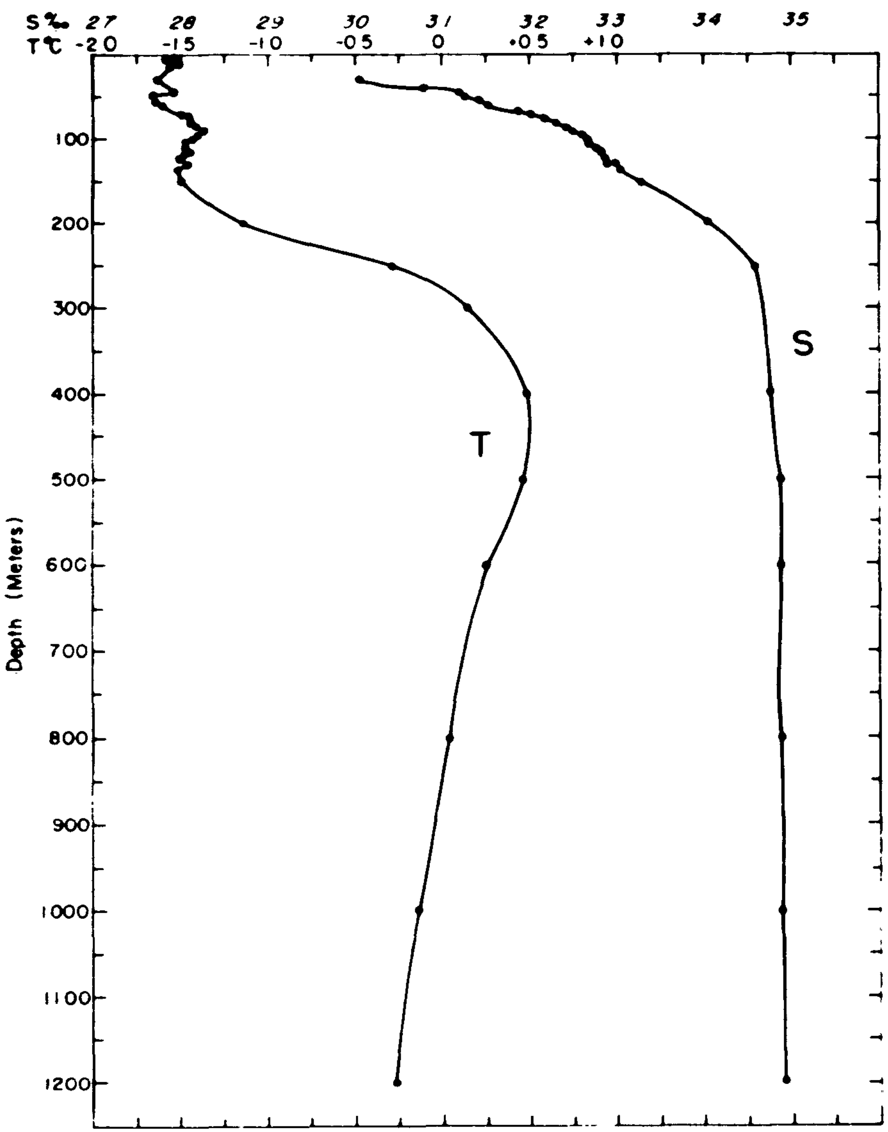
STATION NO. 75 + 76



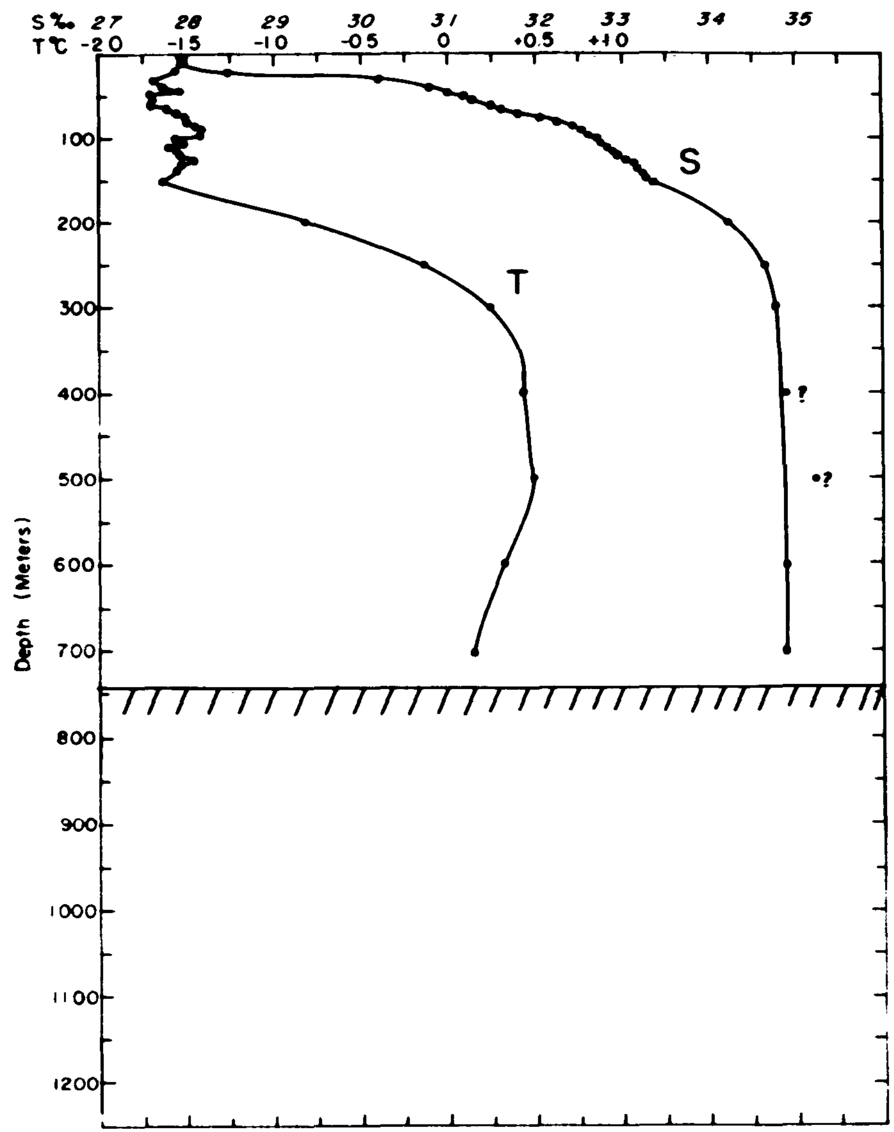
STATION NO. 77 + 78



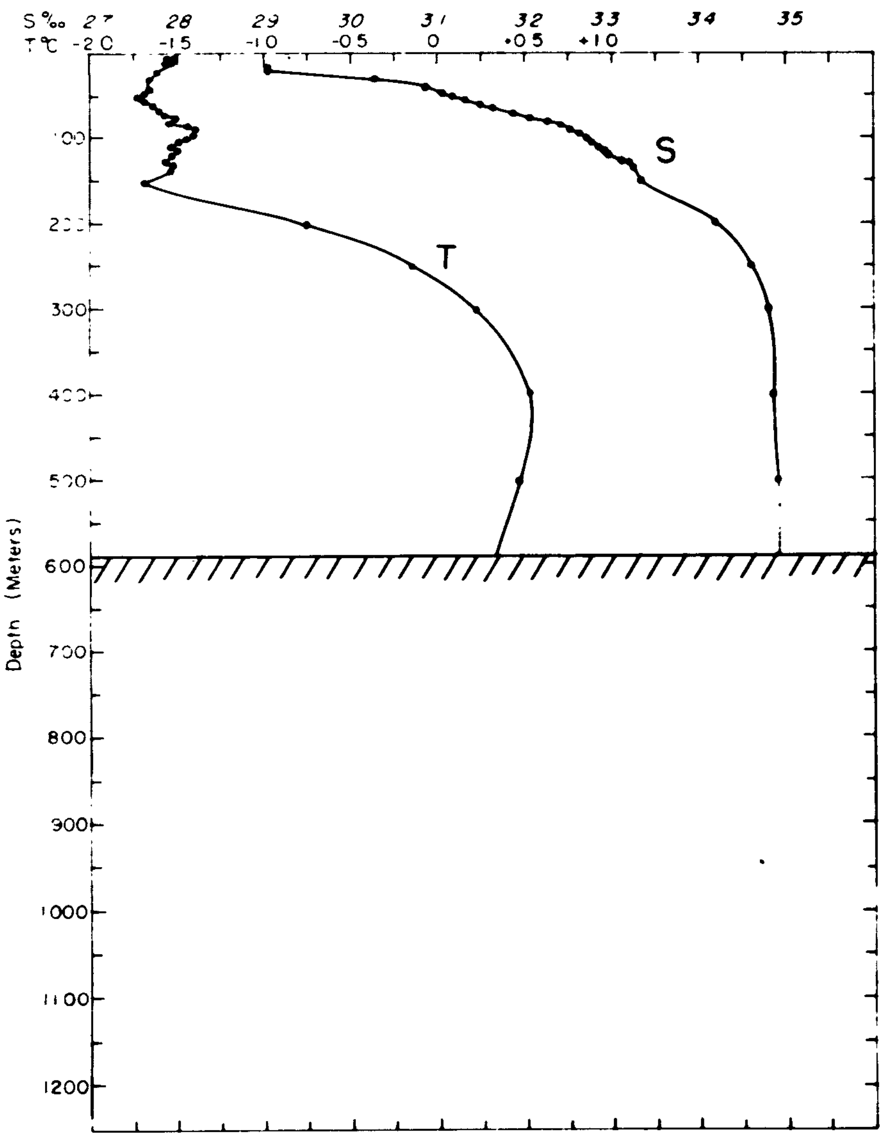
STATION NO. 79+80



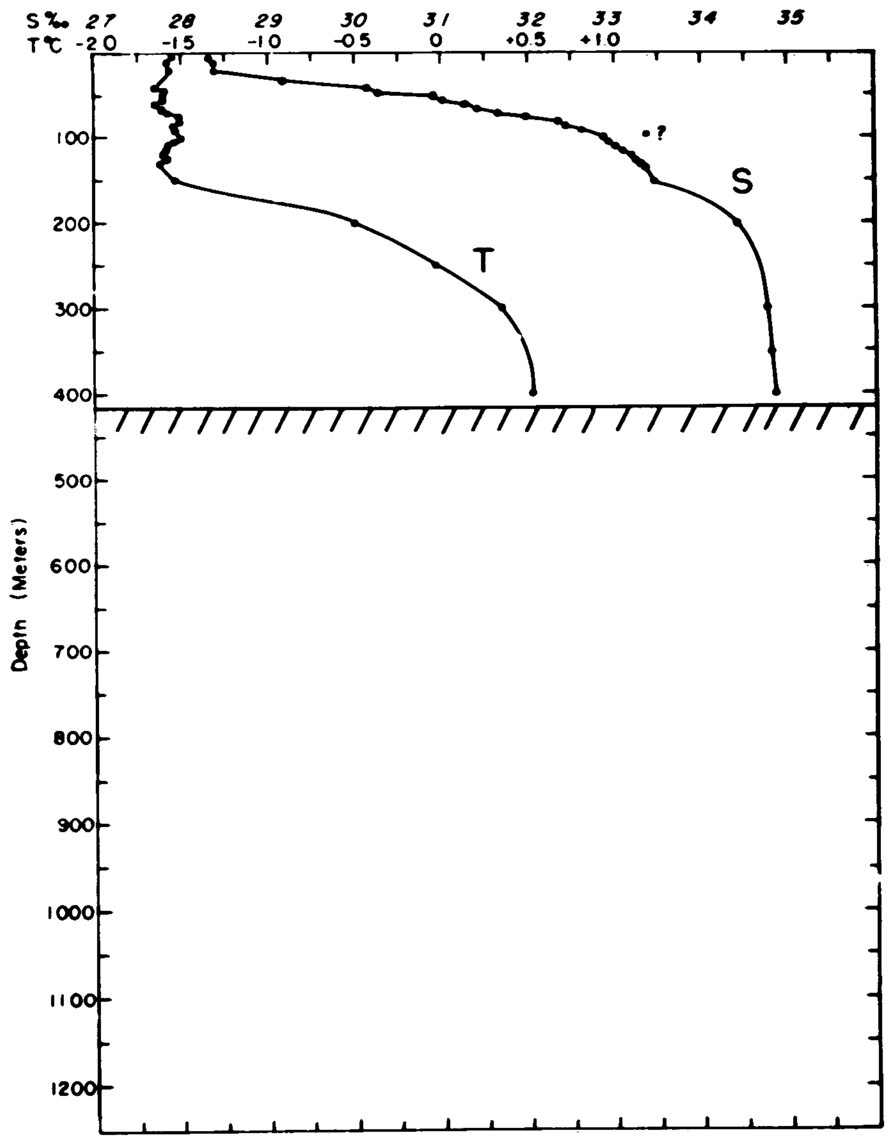
STATION NO. 81+82



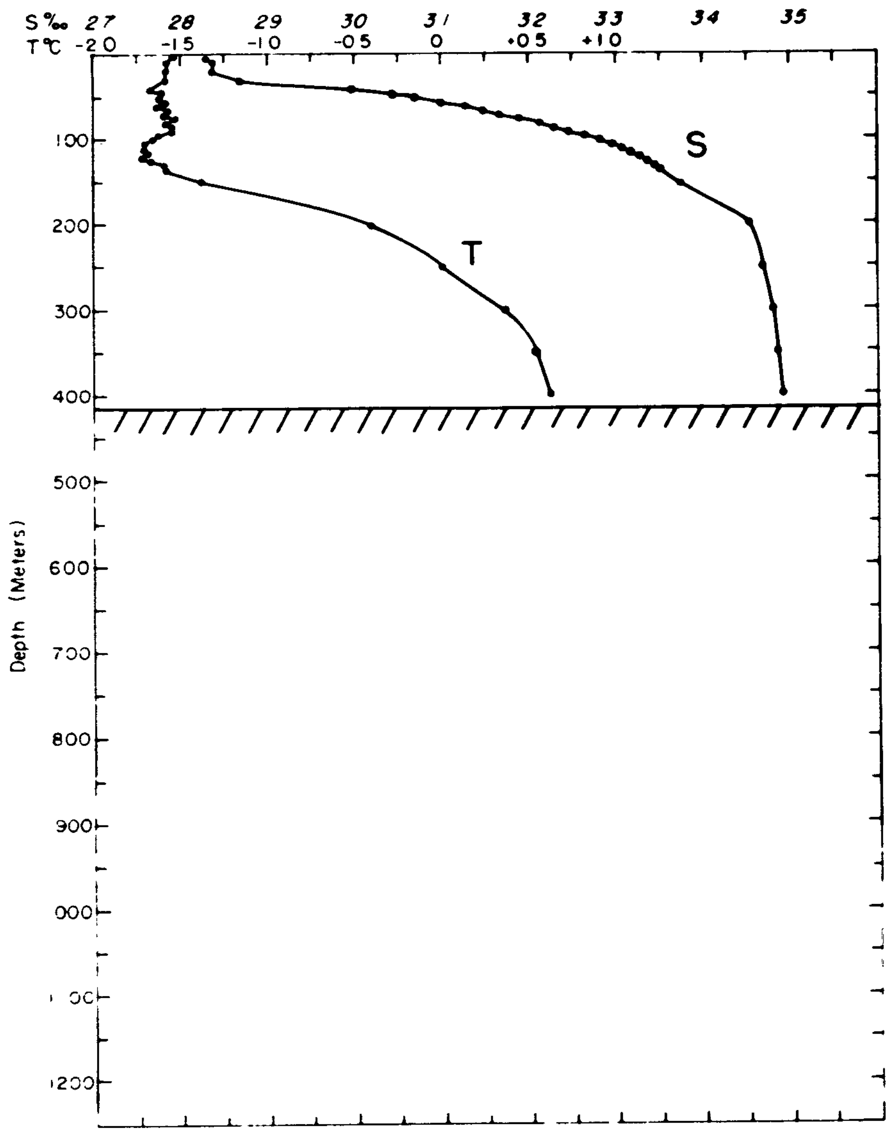
STATION NO. 83+84



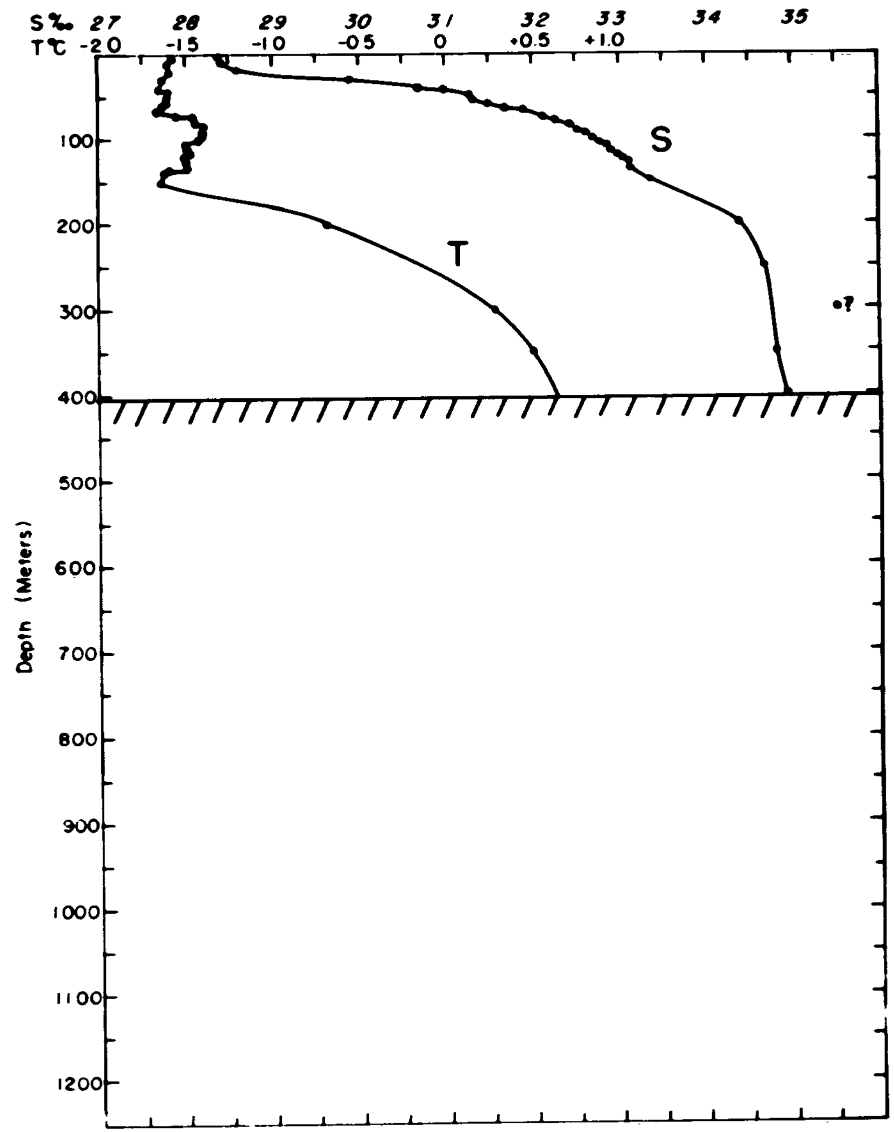
STATION NO. 85+86



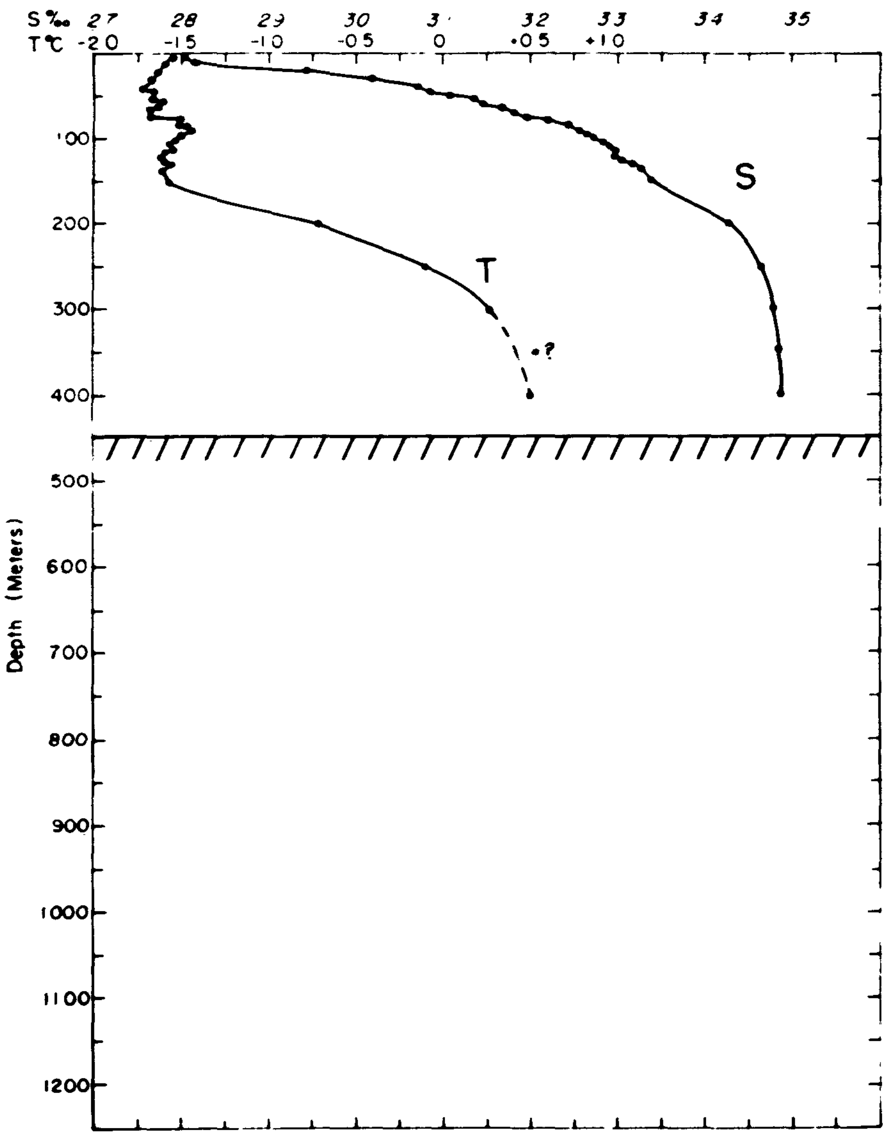
STATION NO. 87+88



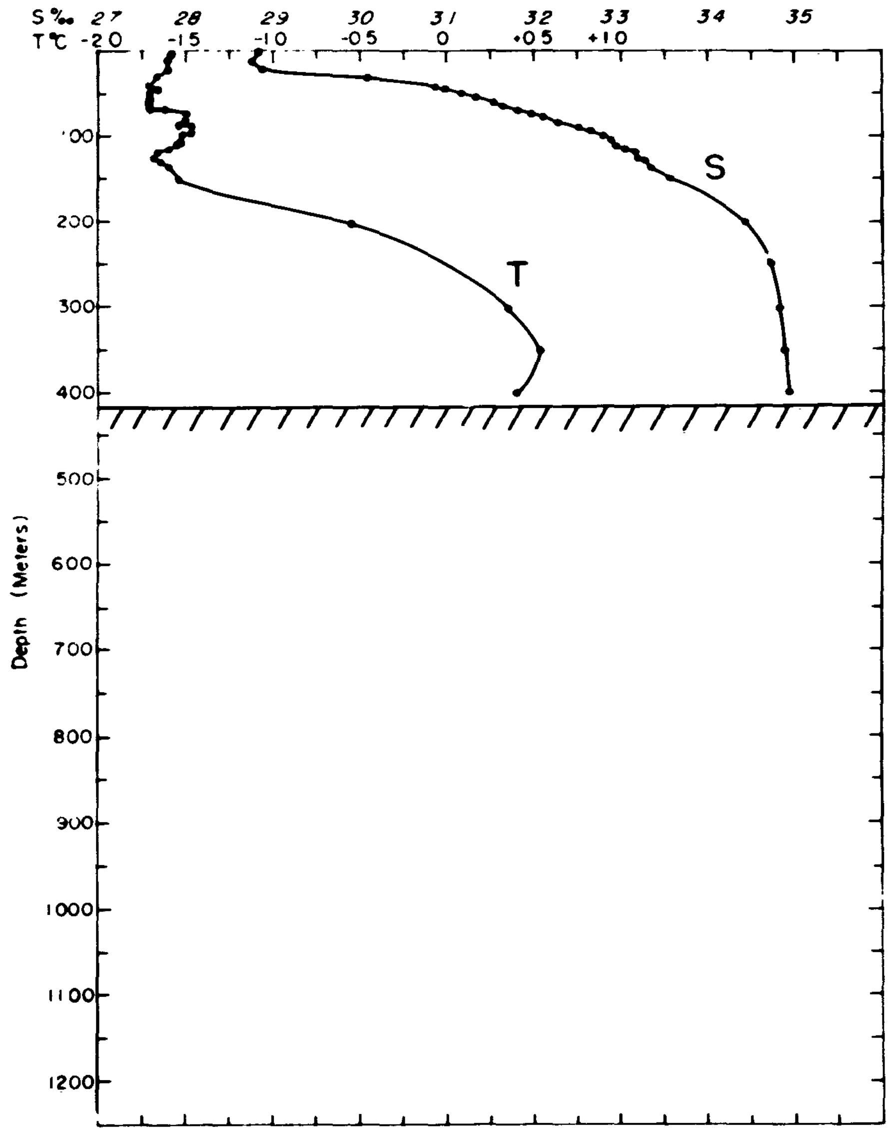
STATION NO. 89+90



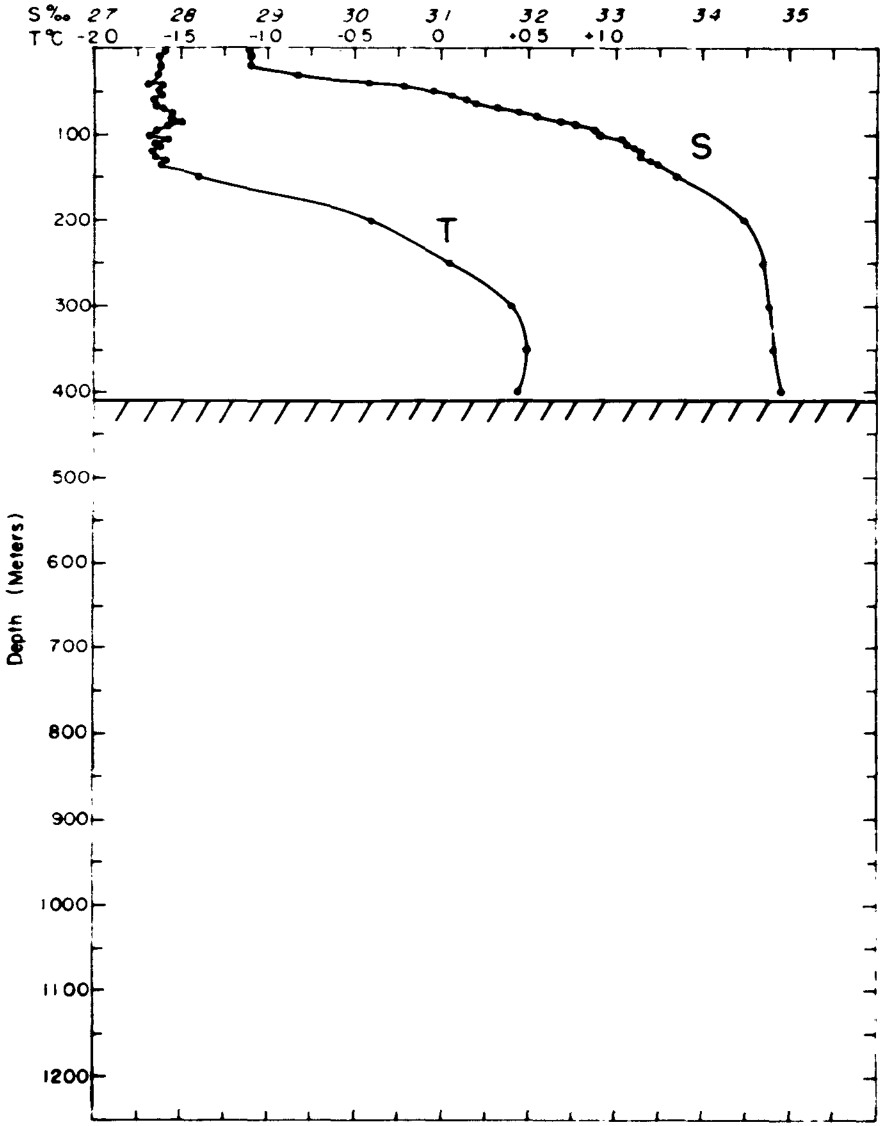
STATION NO 91+92



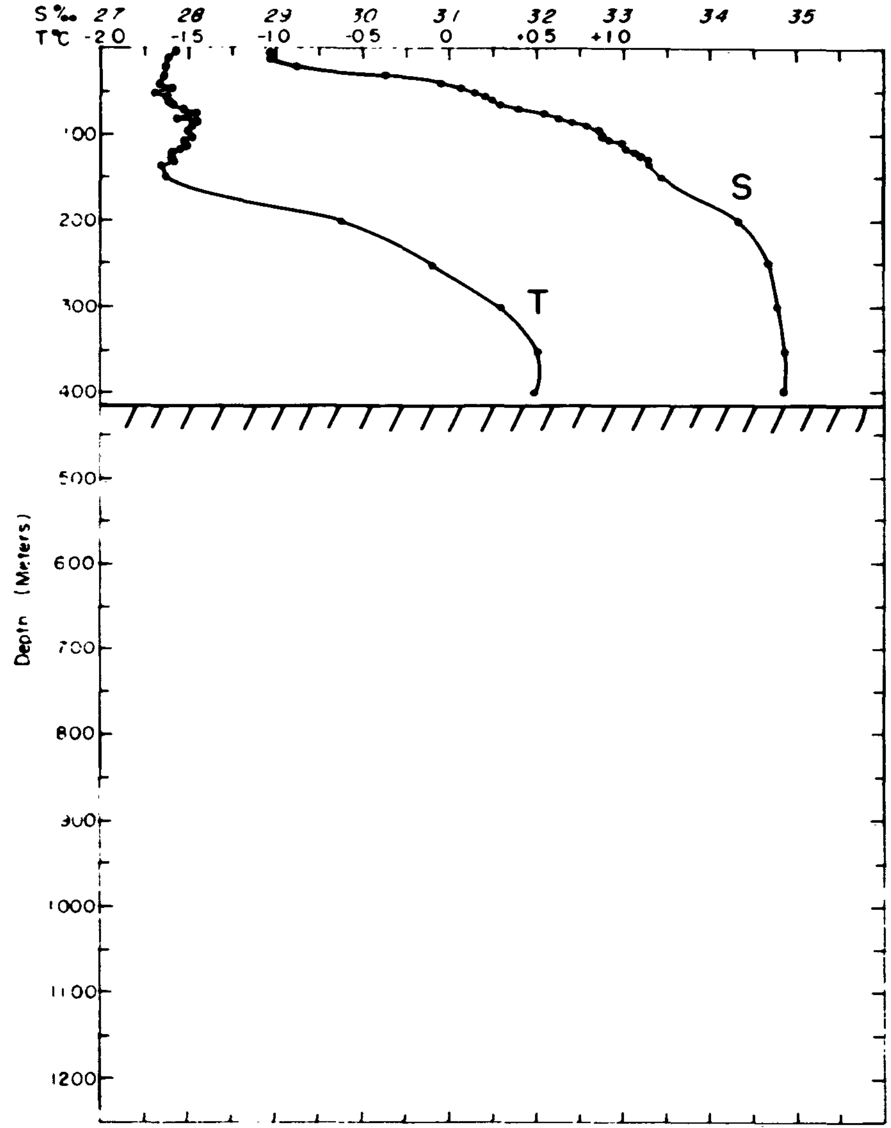
STATION NO. 93+94



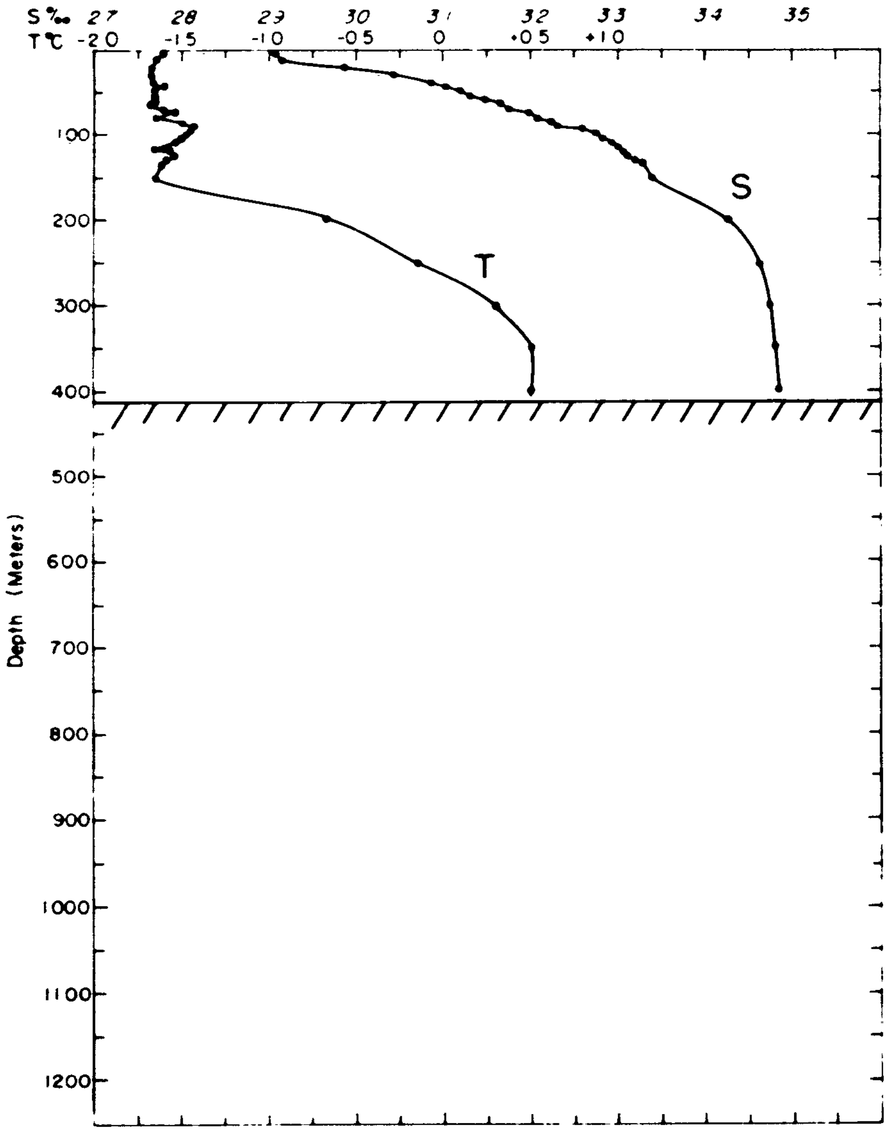
STATION NO 95+96



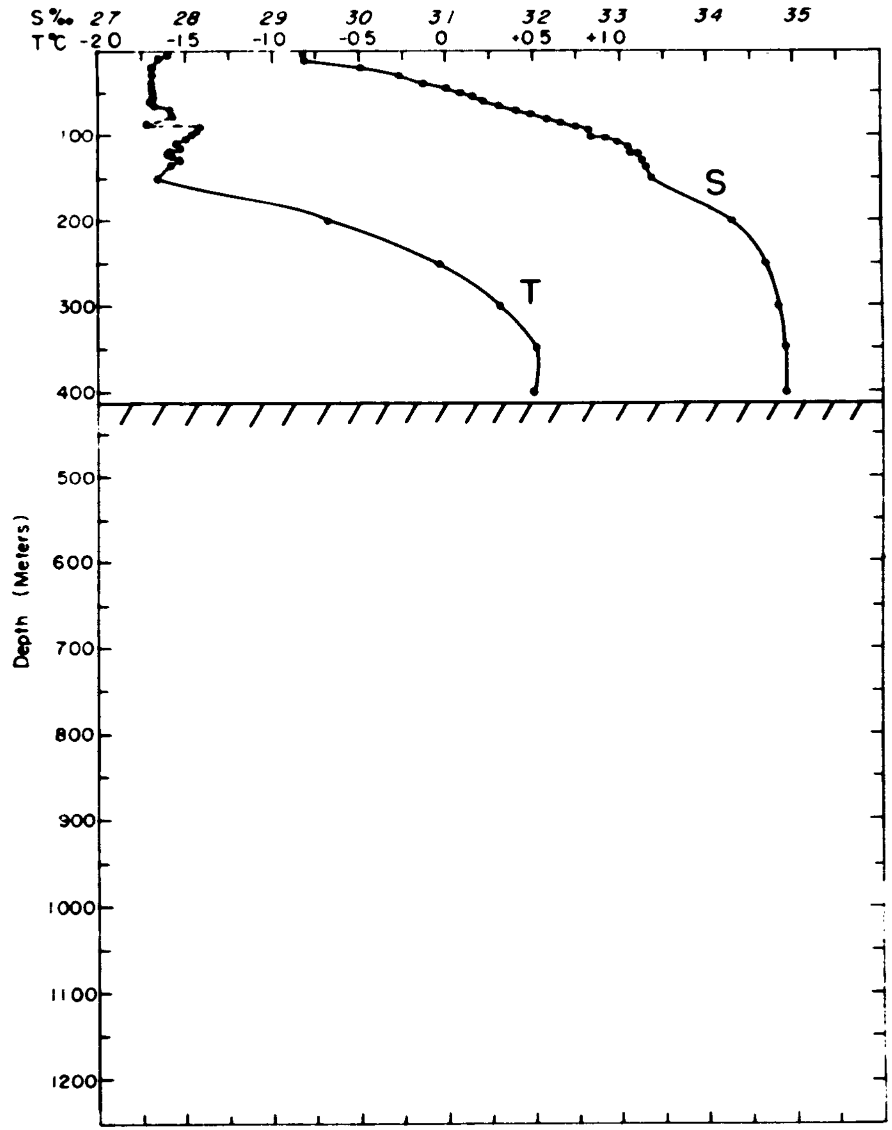
STATION NO. 97+98



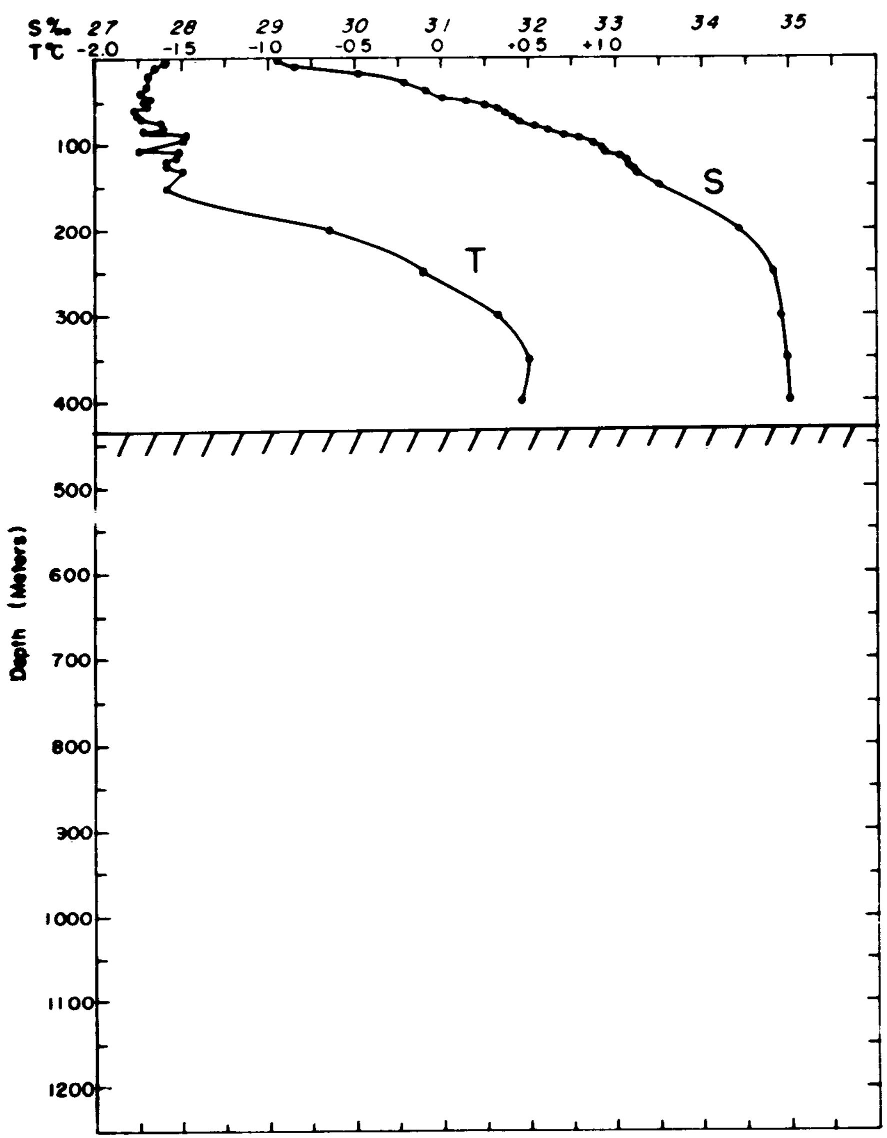
STATION NO 99+100



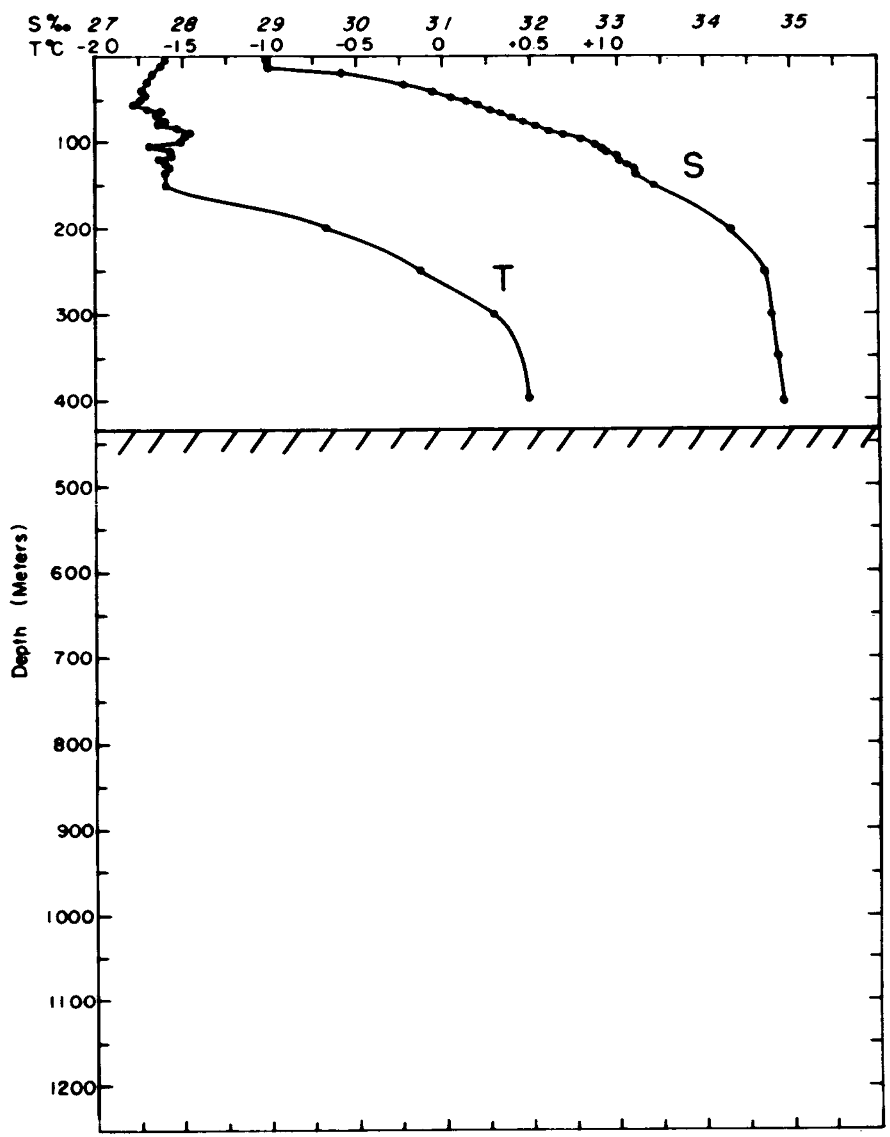
STATION NO. 101+102



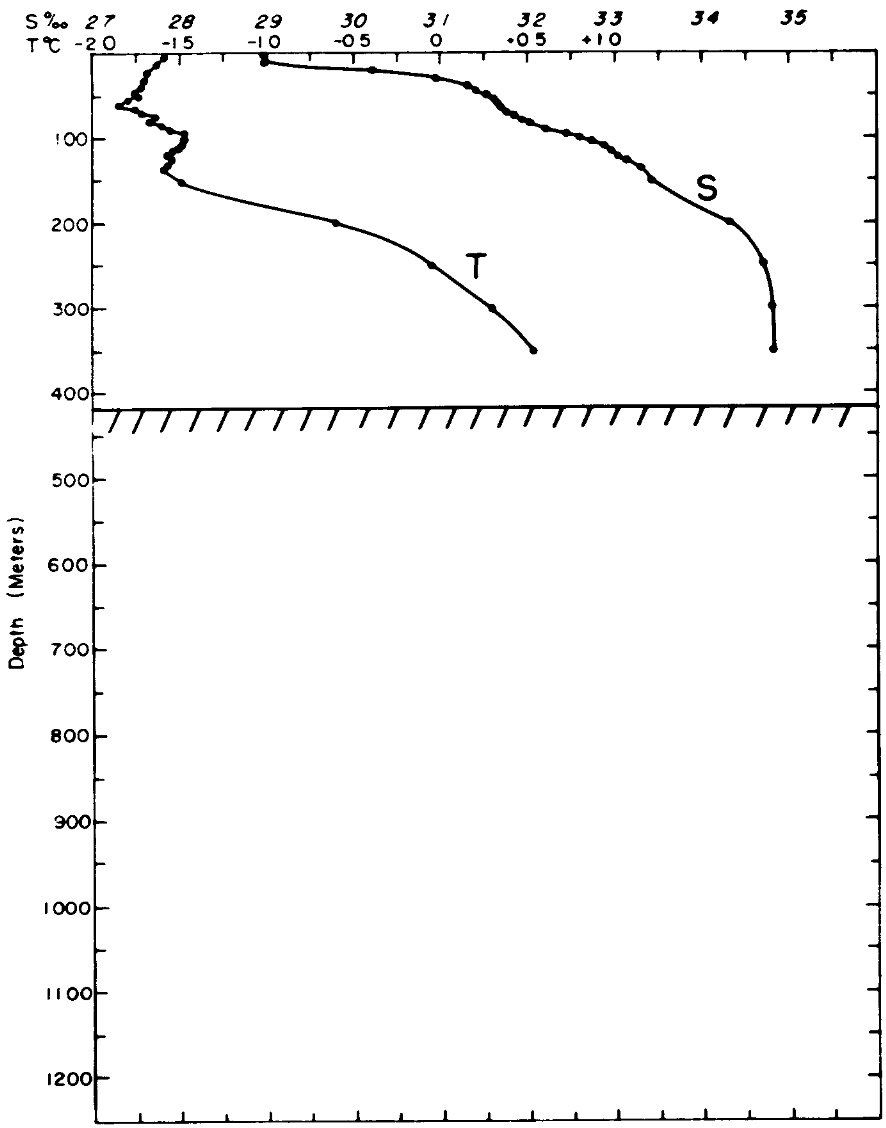
STATION NO. 103+104



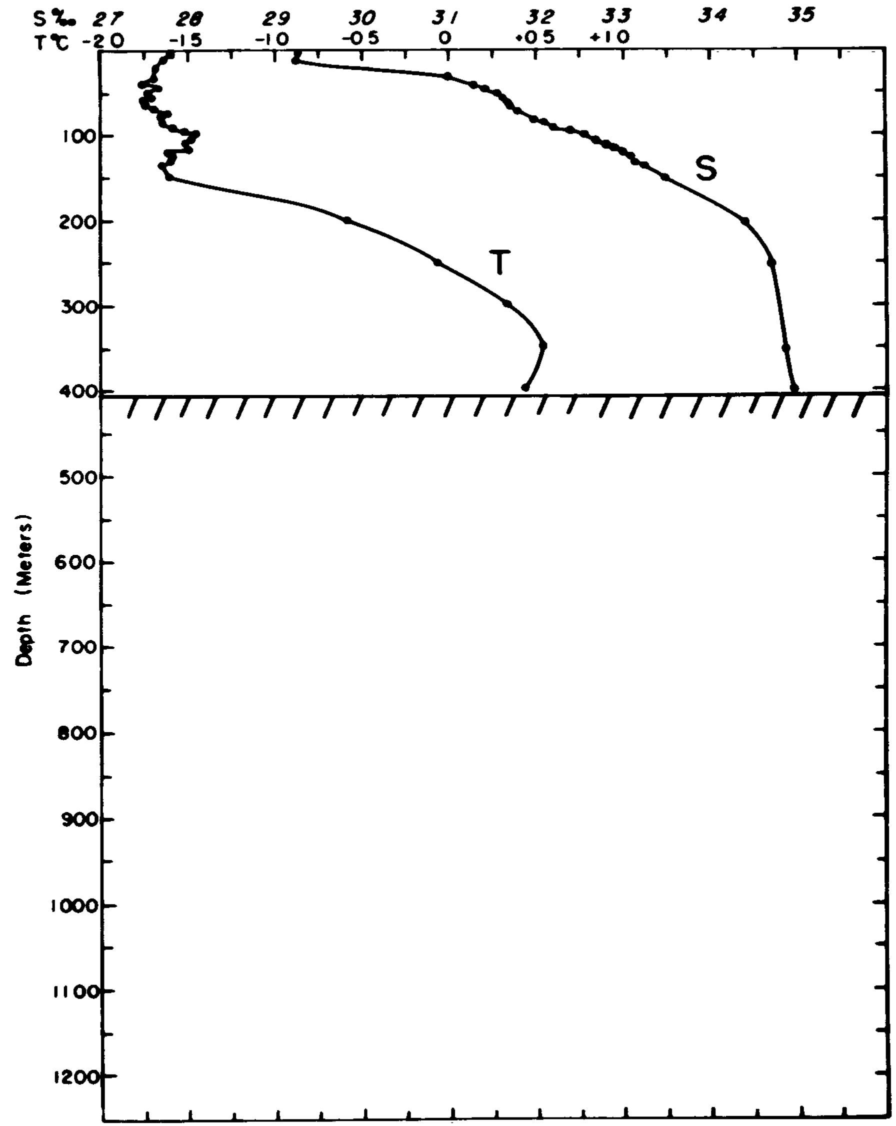
STATION NO. 105+106



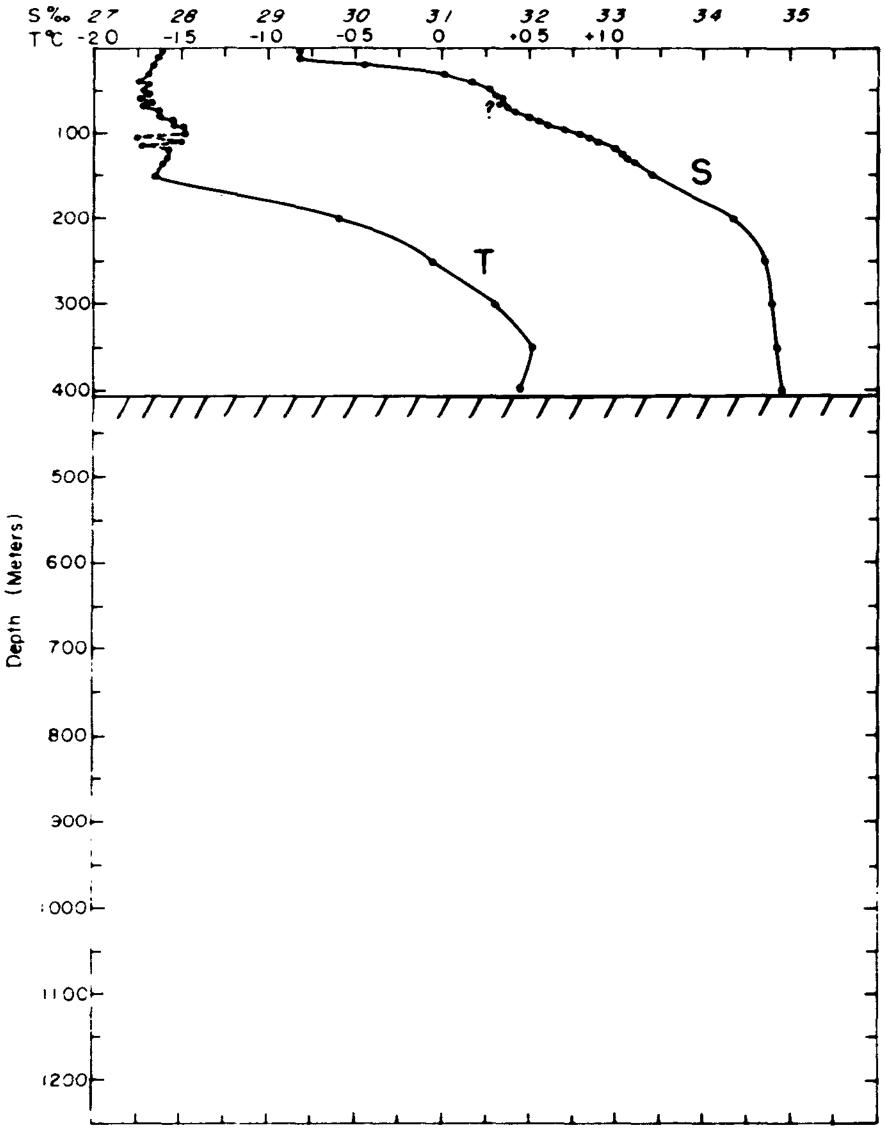
STATION NO. 107 + 108



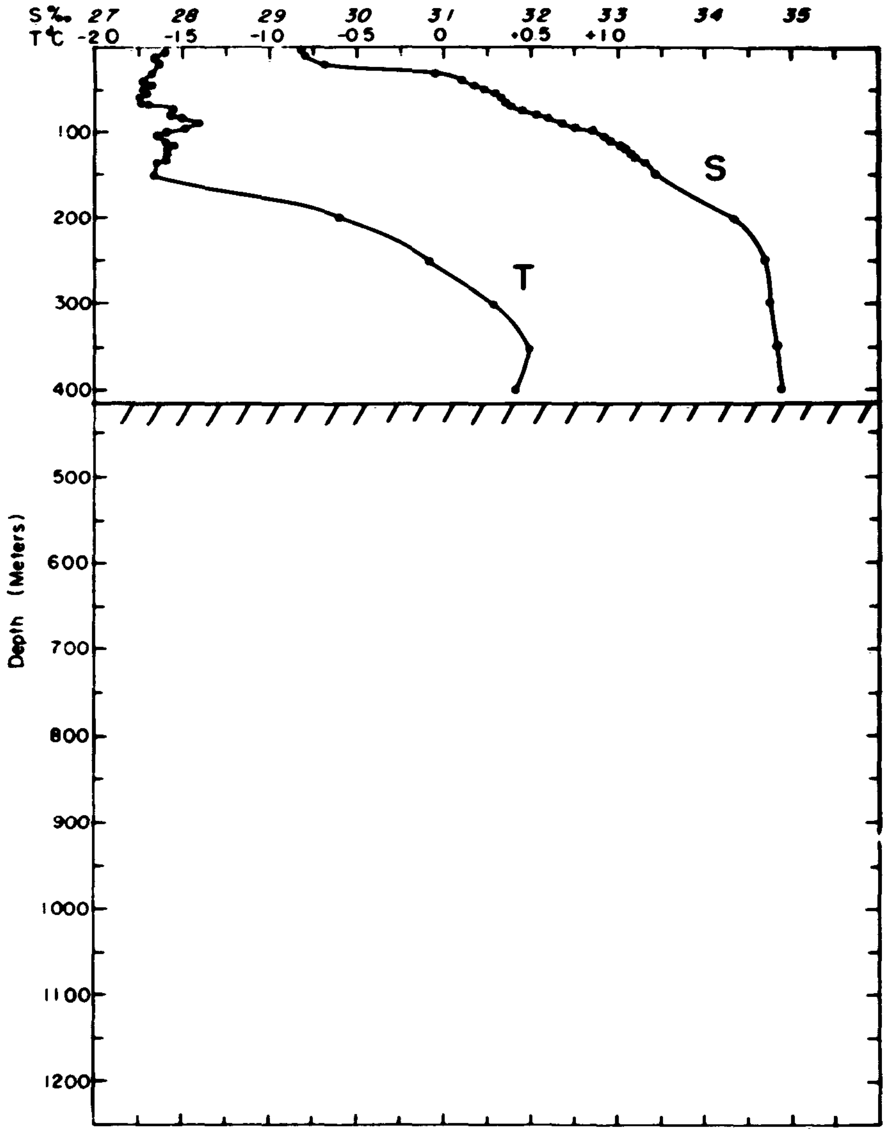
STATION NO. 109+110



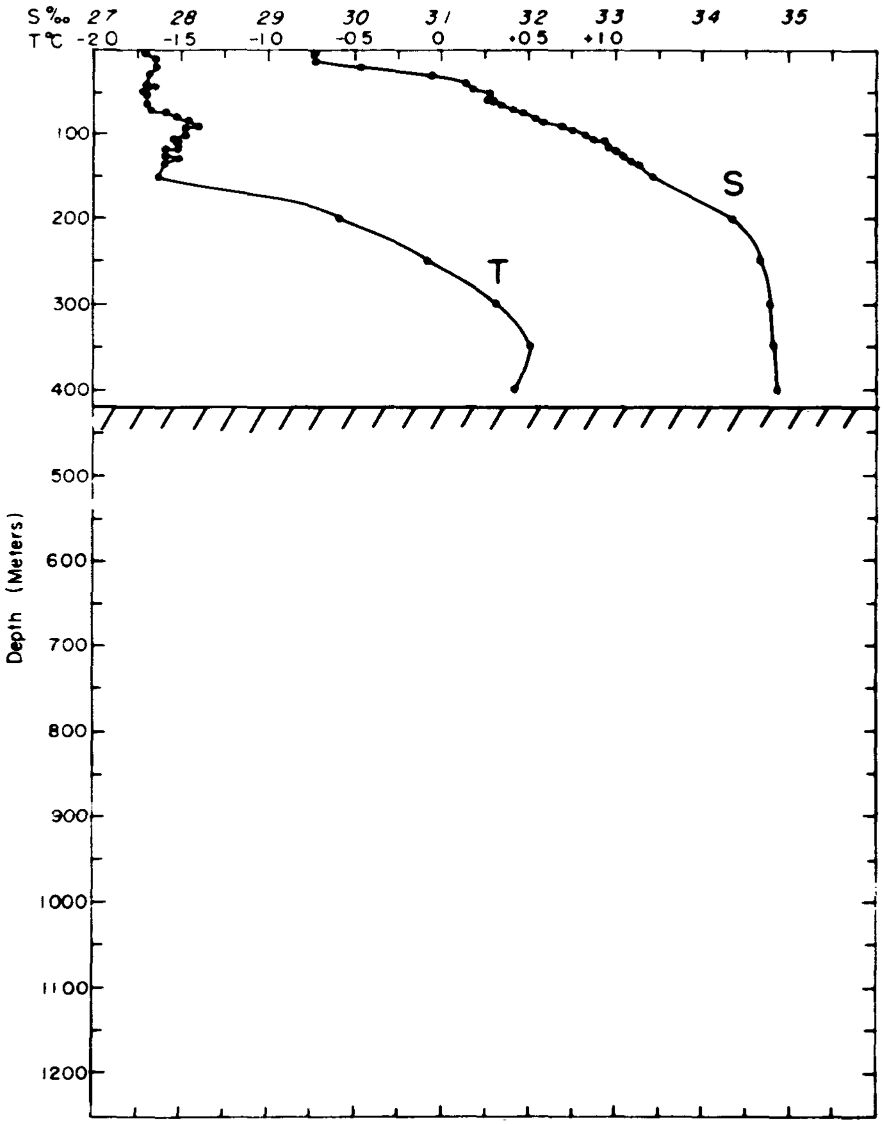
STATION NO. 111 + 112



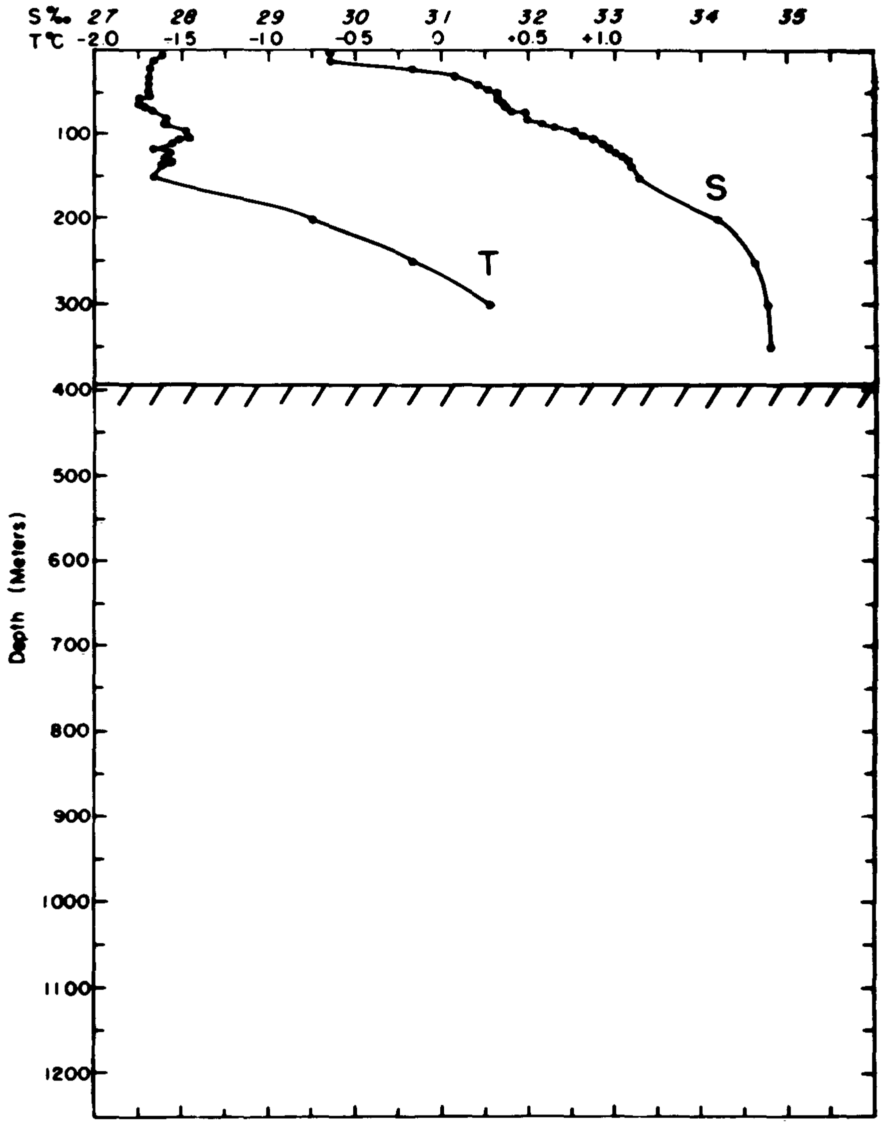
STATION NO. 113 + 114



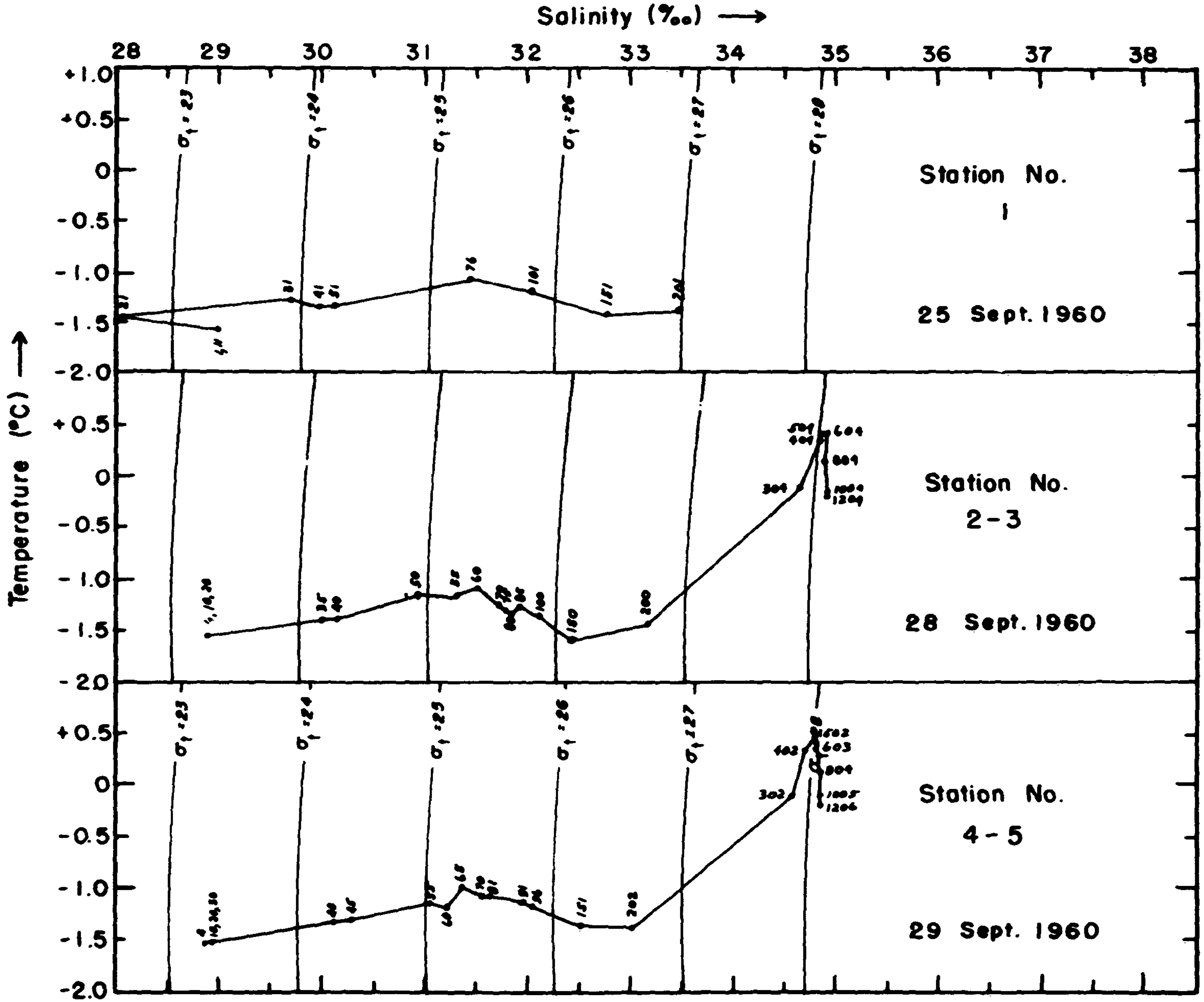
STATION NO. 115 (116)



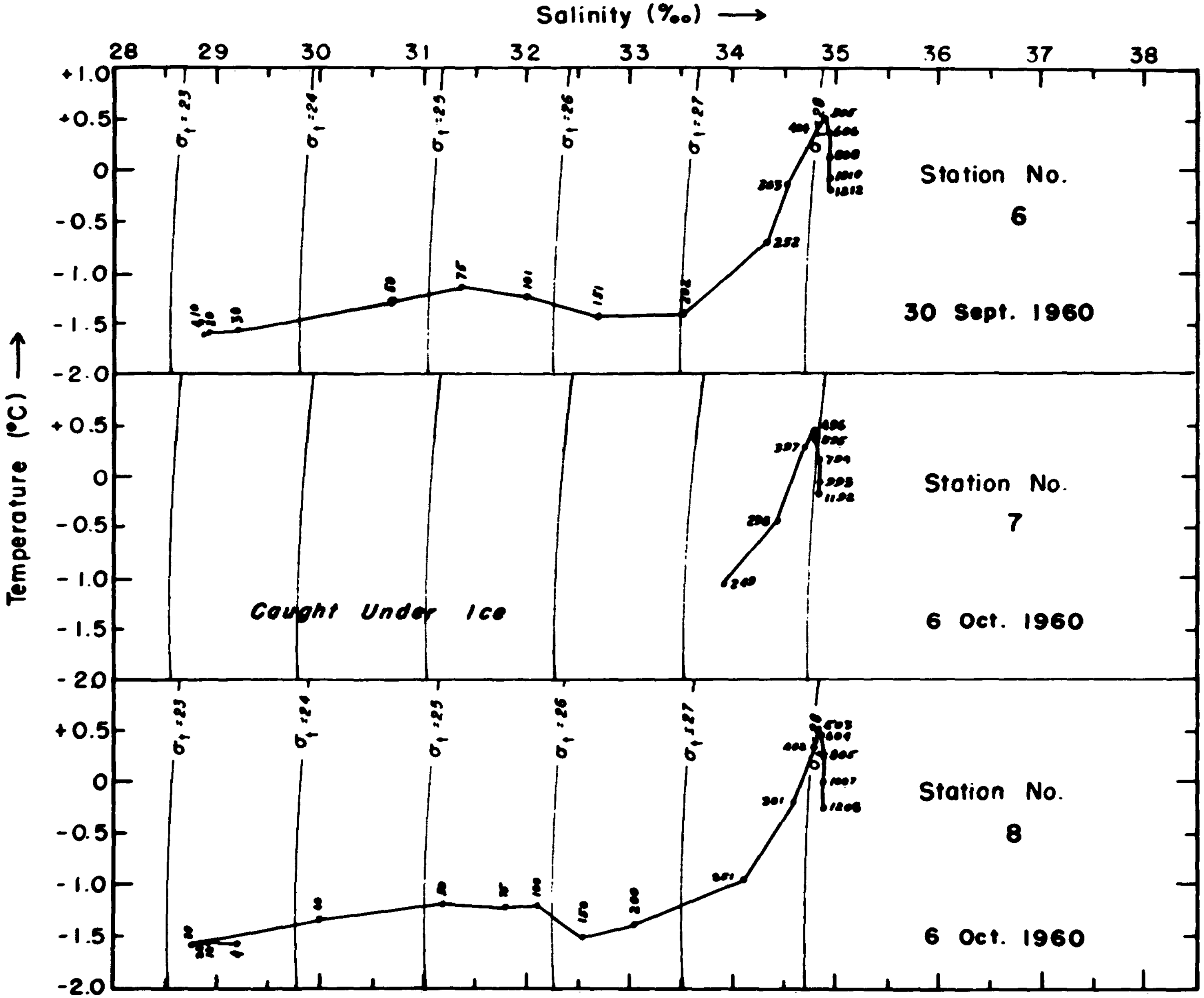
STATION NO. 117 + 118



T-S DIAGRAMS

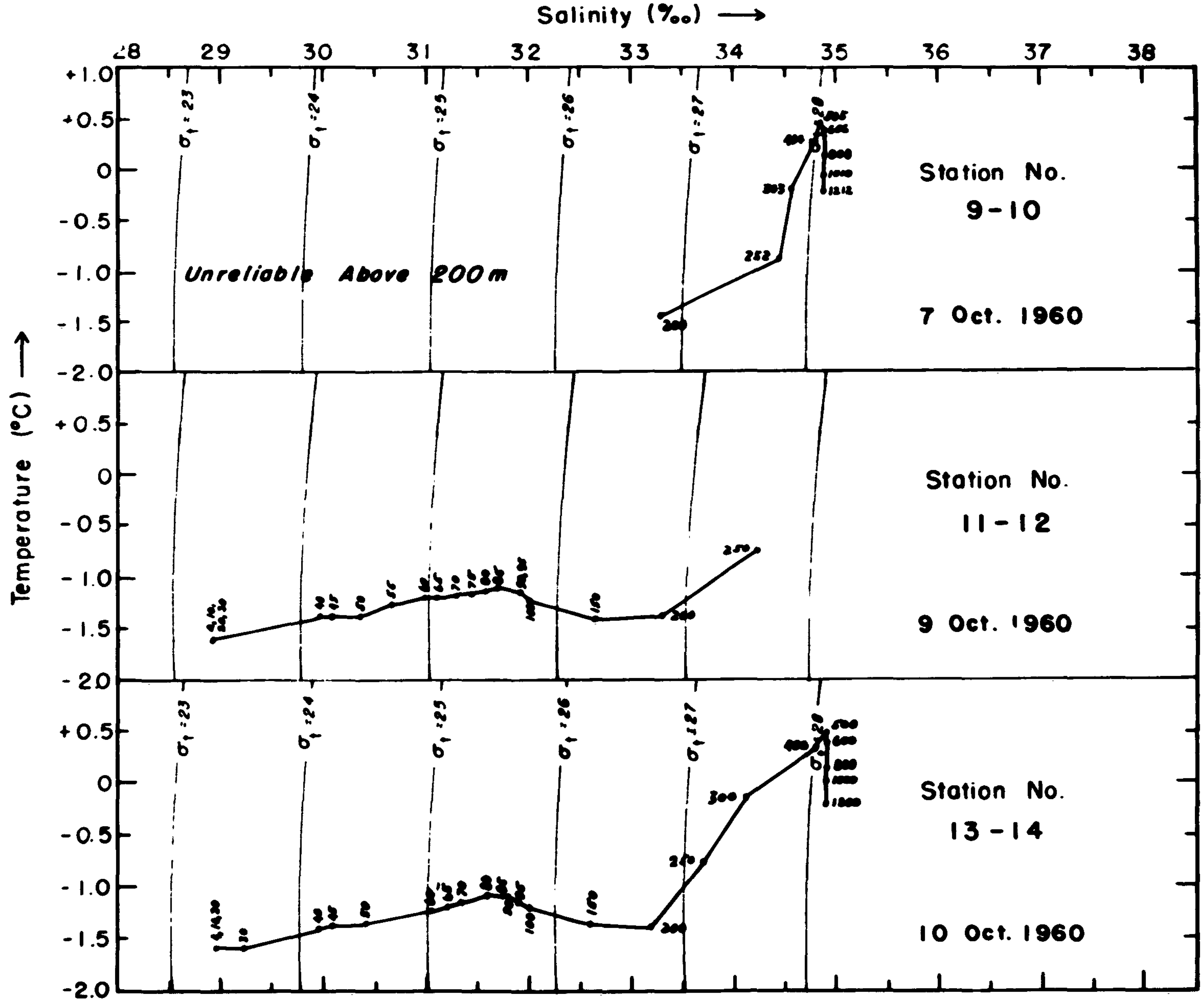

Salinity (‰) ⟶
Temperature (°C) ⟶
28
29
30
31
32
33
34
35
36
37
38
+1.0
+0.5
0
-0.5
-1.0
-1.5
-2.0
$\sigma_t = 23$
$\sigma_t = 24$
$\sigma_t = 25$
$\sigma_t = 26$
$\sigma_t = 27$
$\sigma_t = 28$
Station No.
1
25 Sept. 1960
Station No.
2-3
28 Sept. 1960
Station No.
4-5
29 Sept. 1960

T-S DIAGRAMS

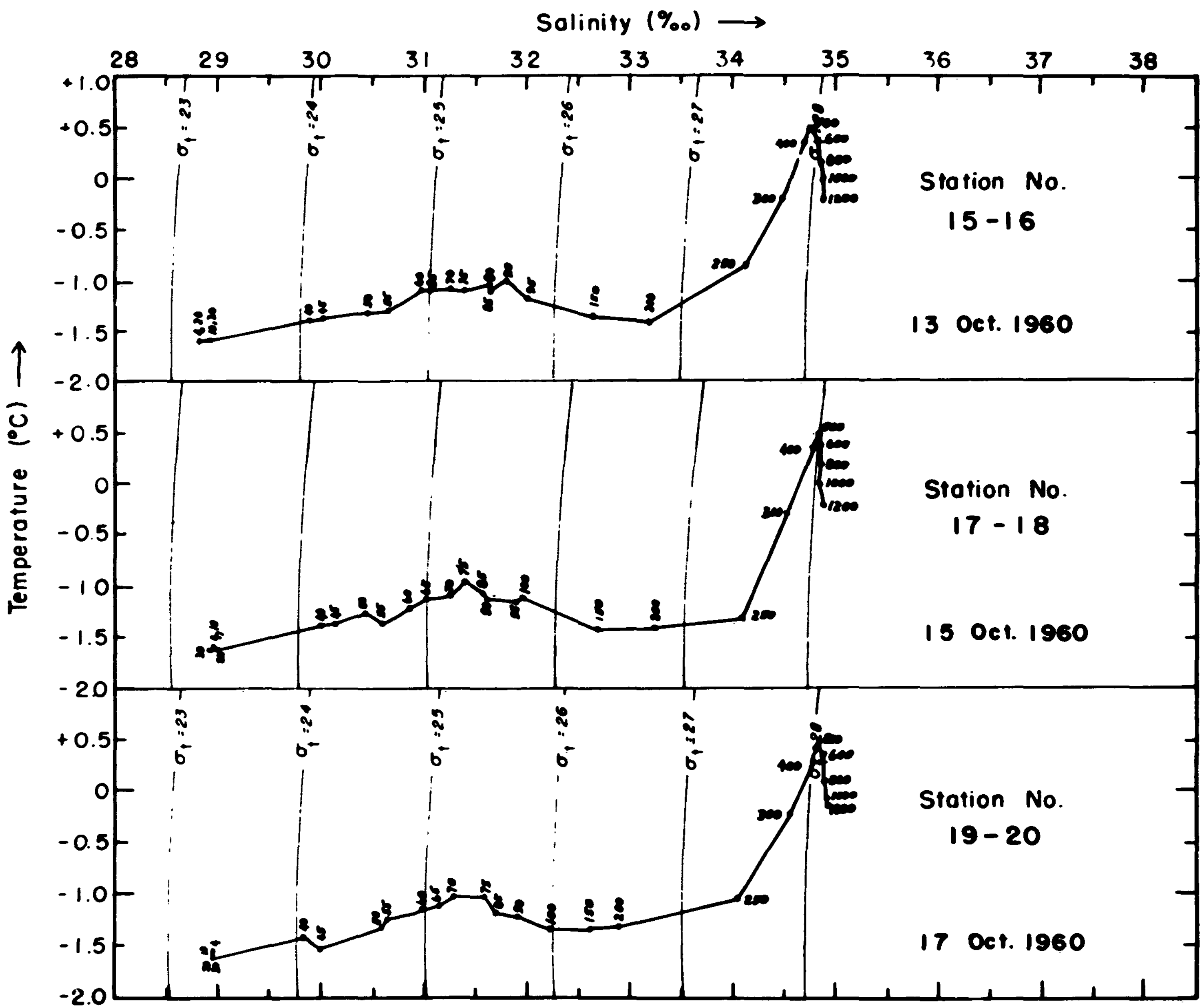


Salinity (‰) →
Temperature (°C) →
Station No. 6
30 Sept. 1960
Station No. 7
6 Oct. 1960
Caught Under Ice
Station No. 8
6 Oct. 1960

T-S DIAGRAMS

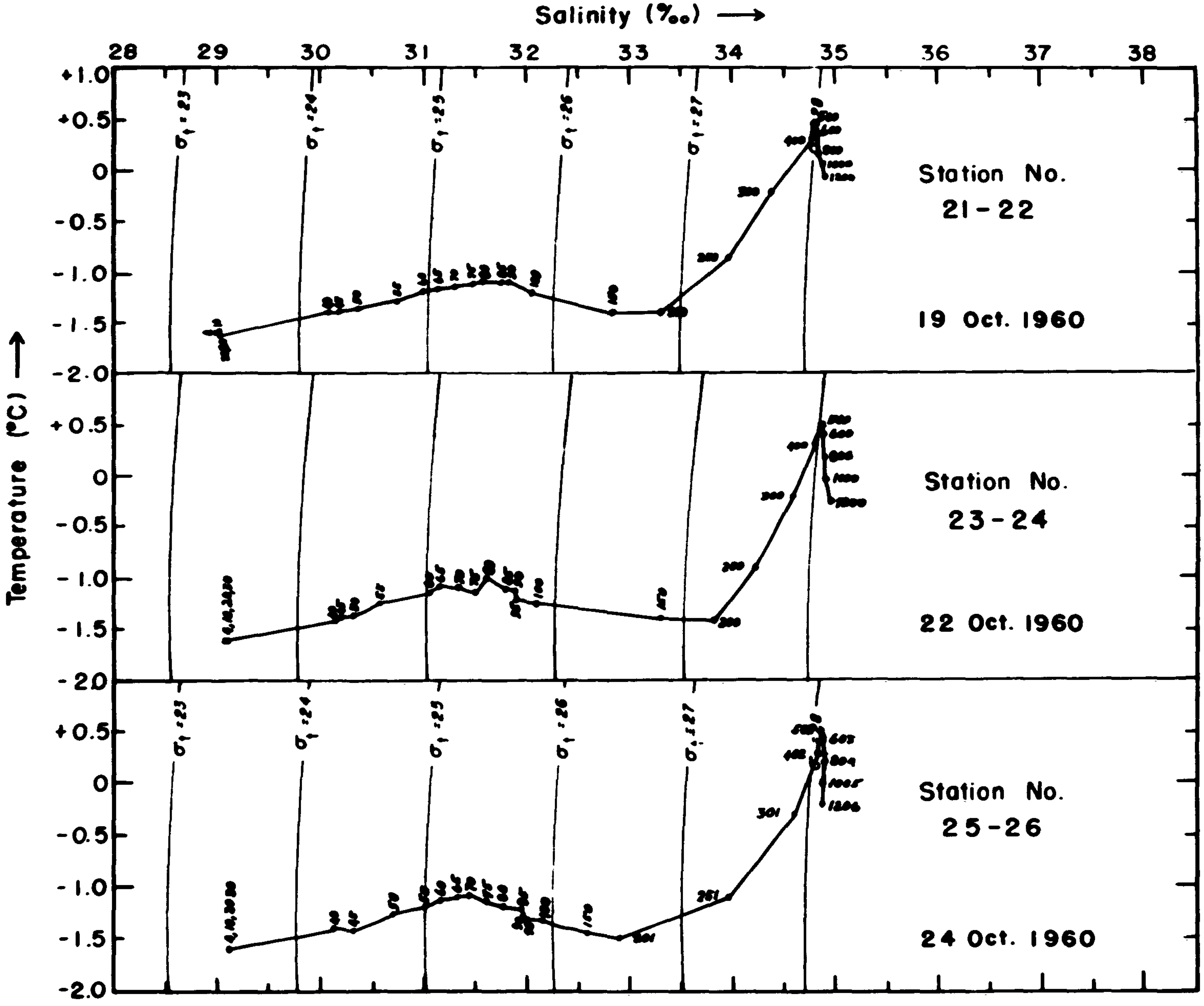

Salinity (‰) ⟶
28
29
30
31
32
33
34
35
36
37
38
Temperature (°C) ⟶
+1.0
+0.5
0
-0.5
-1.0
-1.5
-2.0
σ_t = 23
σ_t = 24
σ_t = 25
σ_t = 26
σ_t = 27
σ_t = 28
Station No.
9-10
7 Oct. 1960
Unreliable Above 200m
Station No.
11-12
9 Oct. 1960
Station No.
13-14
10 Oct. 1960

T-S DIAGRAMS



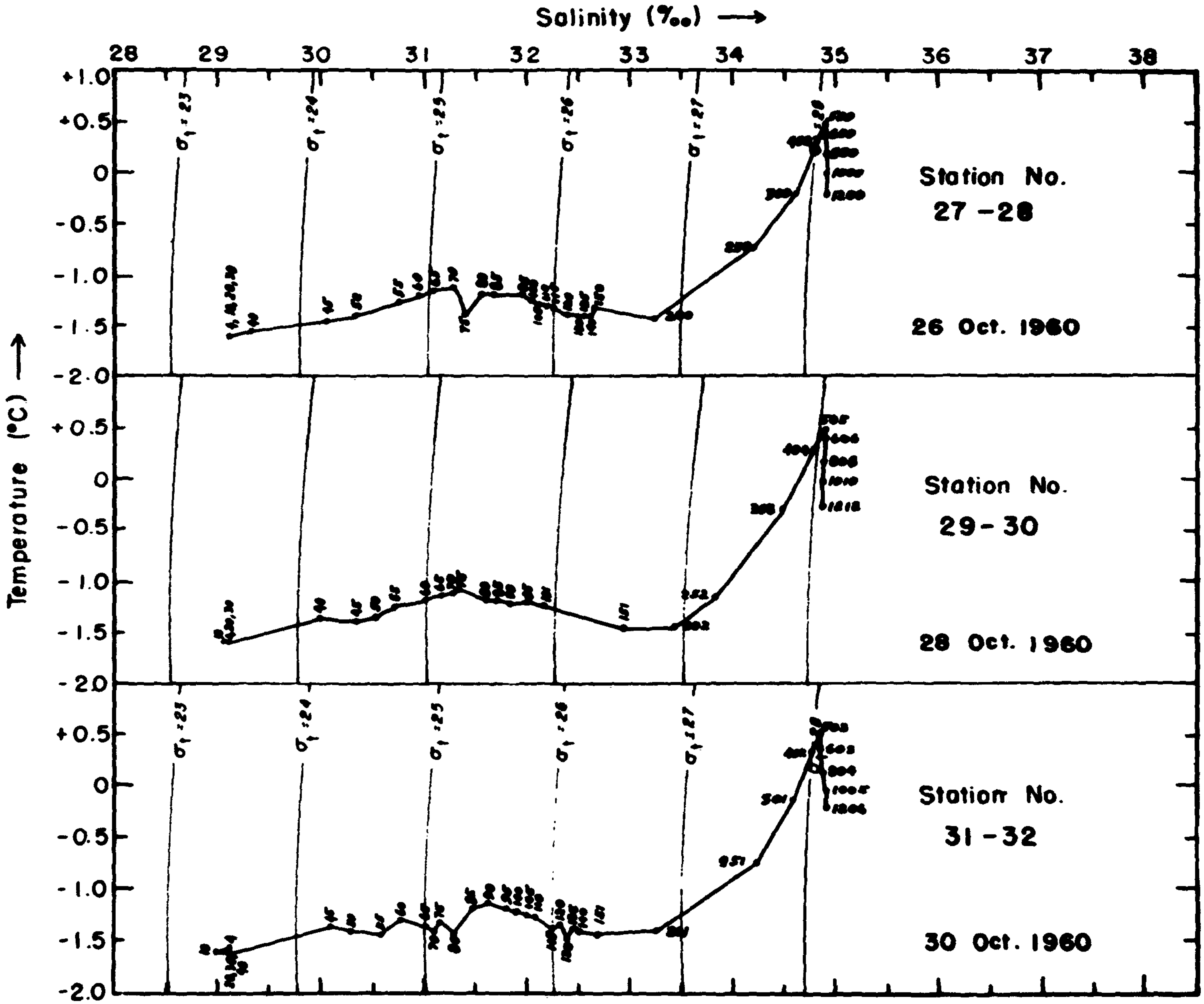
Salinity (‰) ⟶
Temperature (°C) ⟶
Station No. 15-16
13 Oct. 1960
Station No. 17-18
15 Oct. 1960
Station No. 19-20
17 Oct. 1960

T-S DIAGRAMS



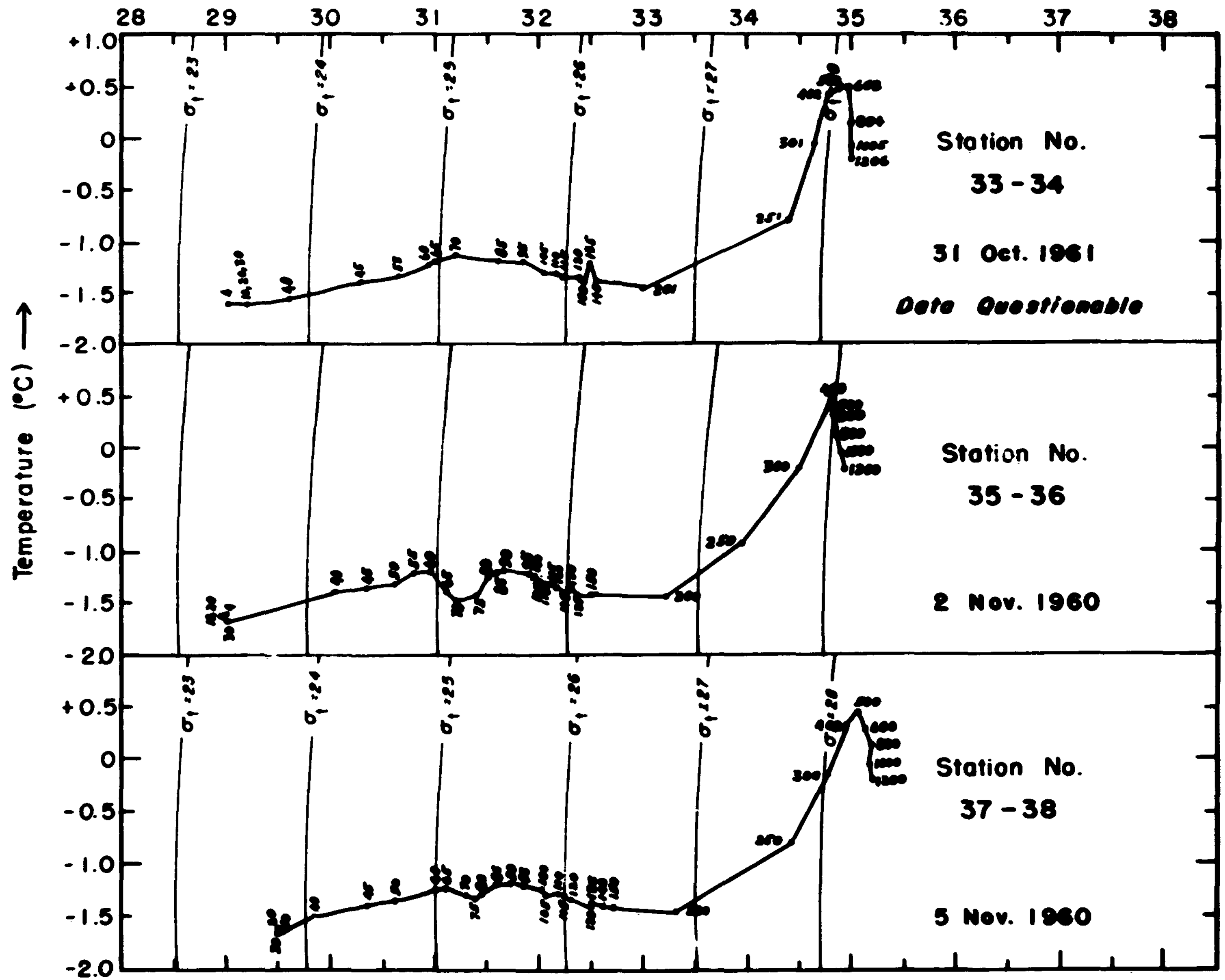
Salinity (‰) →
Temperature (°C) →
Station No. 21-22
19 Oct. 1960
Station No. 23-24
22 Oct. 1960
Station No. 25-26
24 Oct. 1960
$\sigma_t = 23$
$\sigma_t = 24$
$\sigma_t = 25$
$\sigma_t = 26$
$\sigma_t = 27$

T-S DIAGRAMS



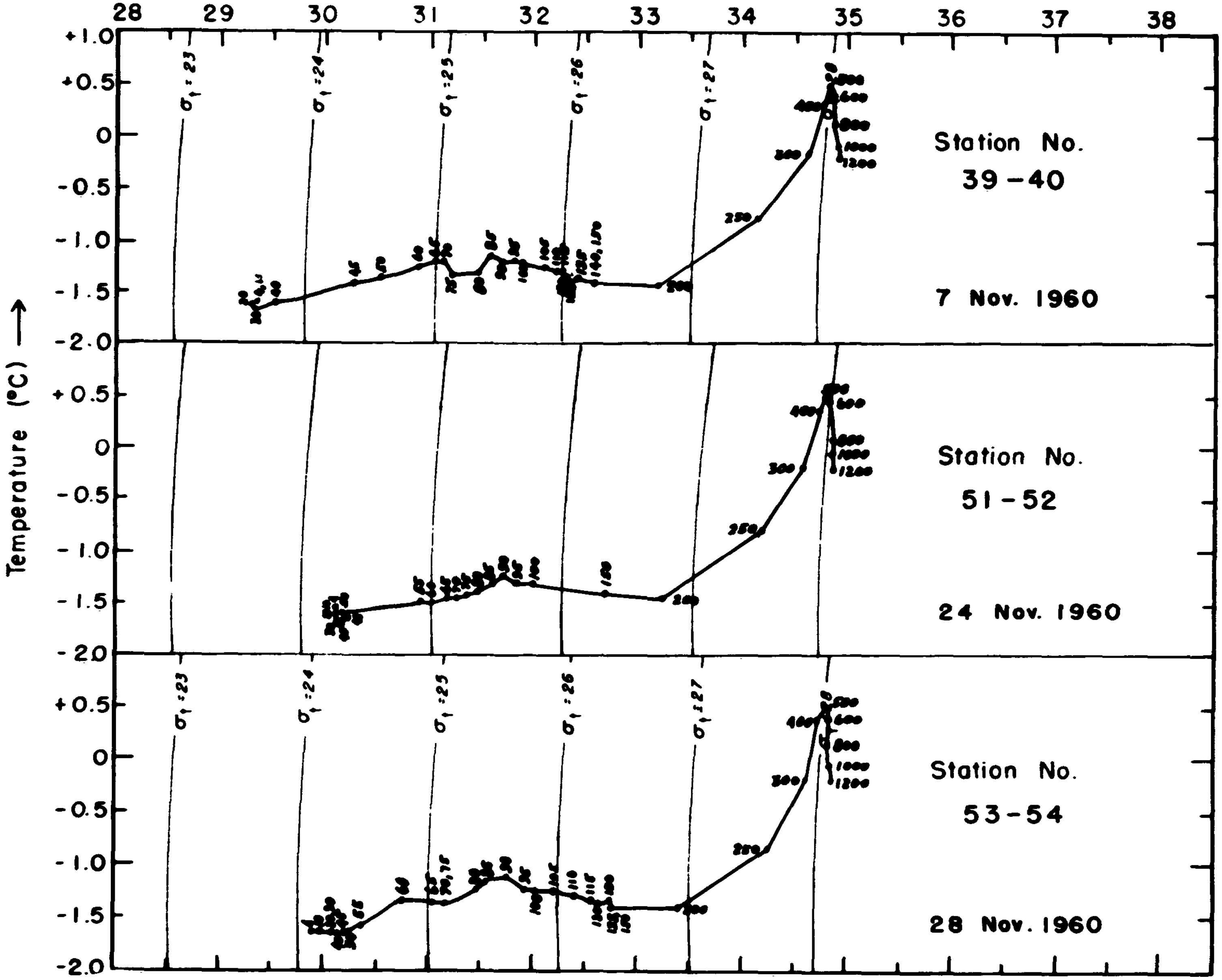
Salinity (‰) →
28
29
30
31
32
33
34
35
36
37
38
Temperature (°C) →
+1.0
+0.5
0
-0.5
-1.0
-1.5
-2.0
$\sigma_t = 23$
$\sigma_t = 24$
$\sigma_t = 25$
$\sigma_t = 26$
$\sigma_t = 27$
Station No.
27 -28
26 Oct. 1960
Station No.
29-30
28 Oct. 1960
Station No.
31 -32
30 Oct. 1960

T-S DIAGRAMS



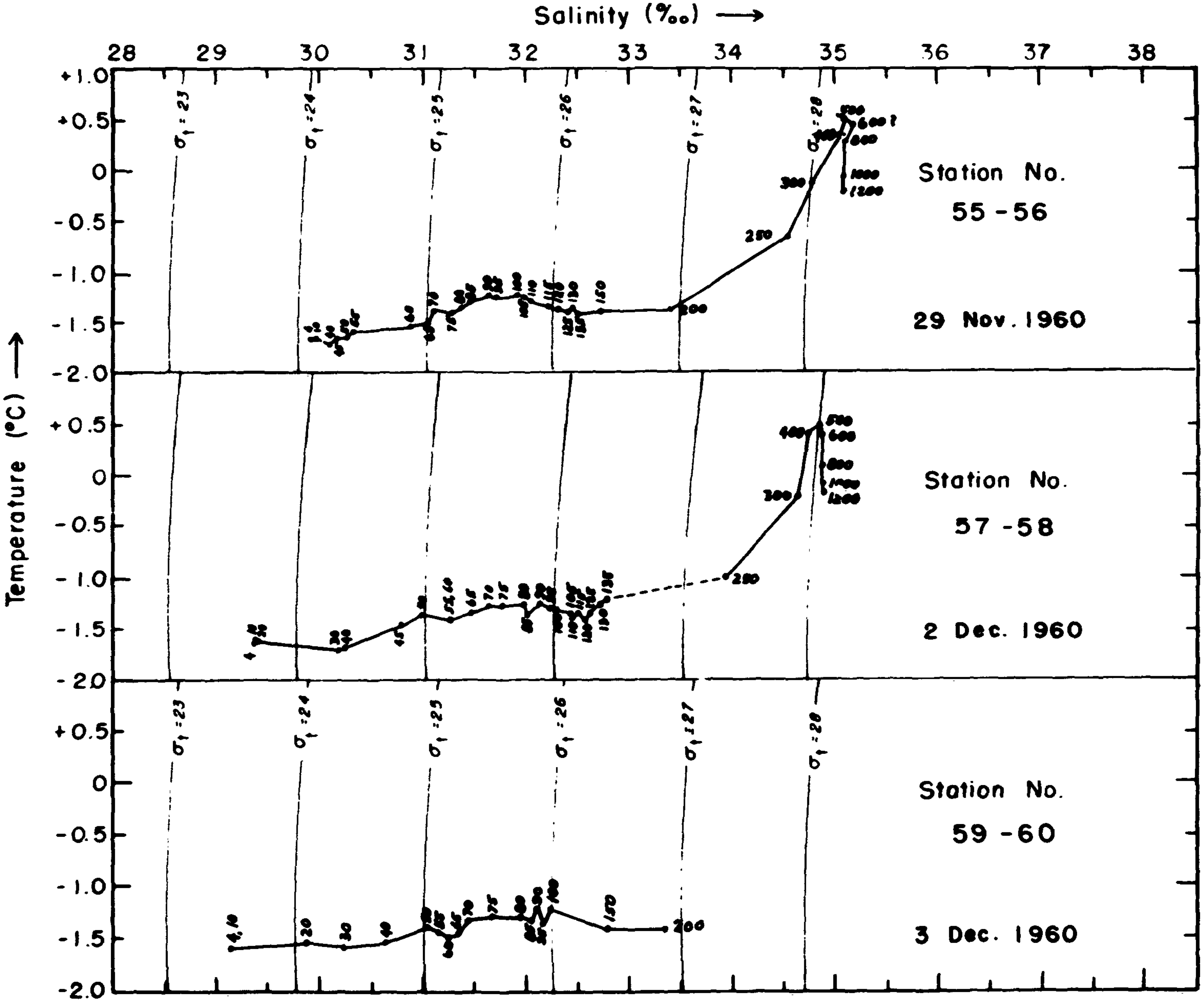
Salinity (‰) ⟶
28
29
30
31
32
33
34
35
36
37
38
Temperature (°C) ⟶
+1.0
+0.5
0
-0.5
-1.0
-1.5
-2.0
$\sigma_t = 23$
$\sigma_t = 24$
$\sigma_t = 25$
$\sigma_t = 26$
$\sigma_t = 27$
$\sigma_t = 28$
Station No.
33 - 34
31 Oct. 1961
Data Questionable
Station No.
35 - 36
2 Nov. 1960
Station No.
37 - 38
5 Nov. 1960

T-S DIAGRAMS

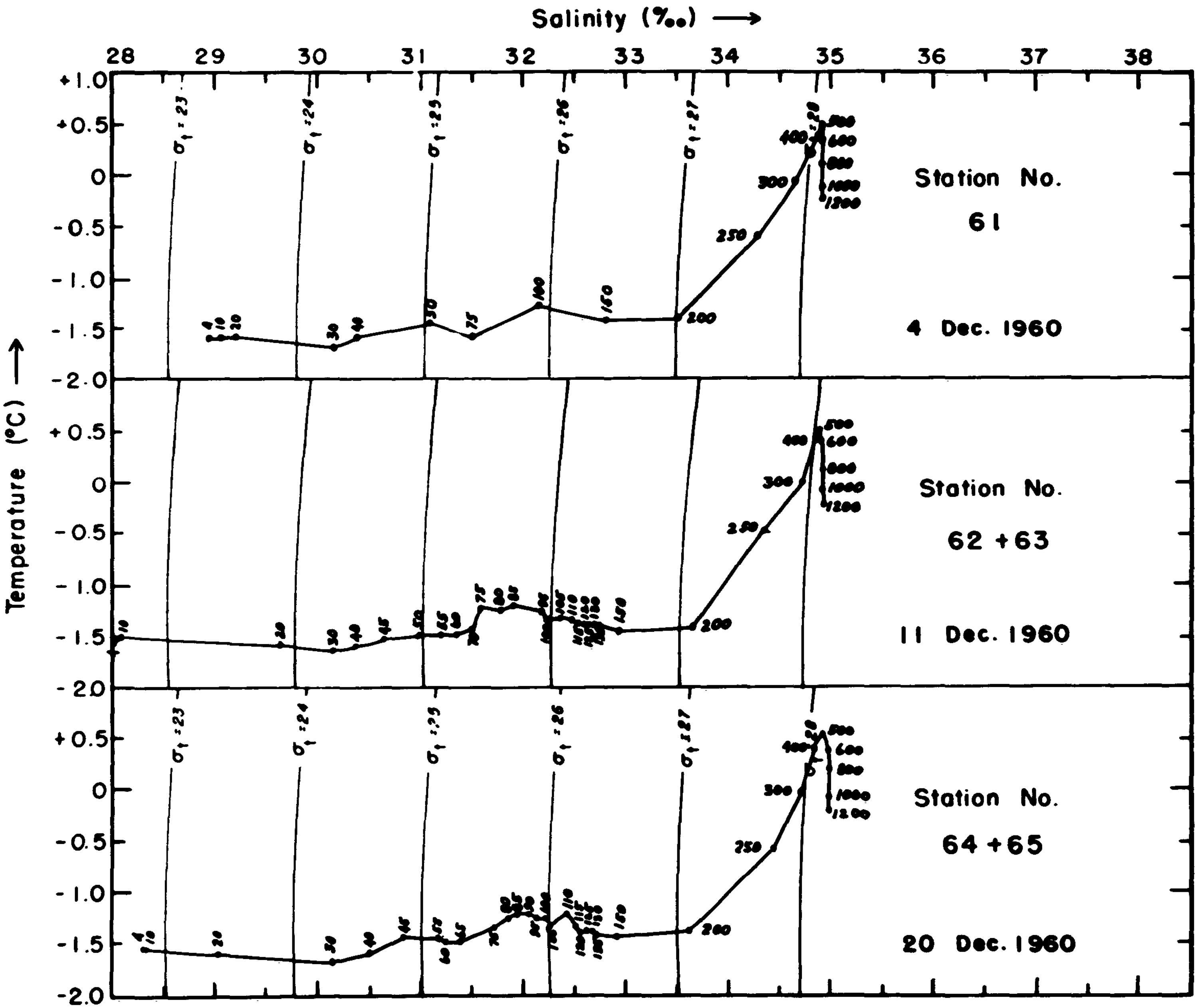


Salinity (‰) ⟶
Temperature (°C) ⟶
Station No. 39 – 40
7 Nov. 1960
Station No. 51 – 52
24 Nov. 1960
Station No. 53 – 54
28 Nov. 1960

T-S DIAGRAMS

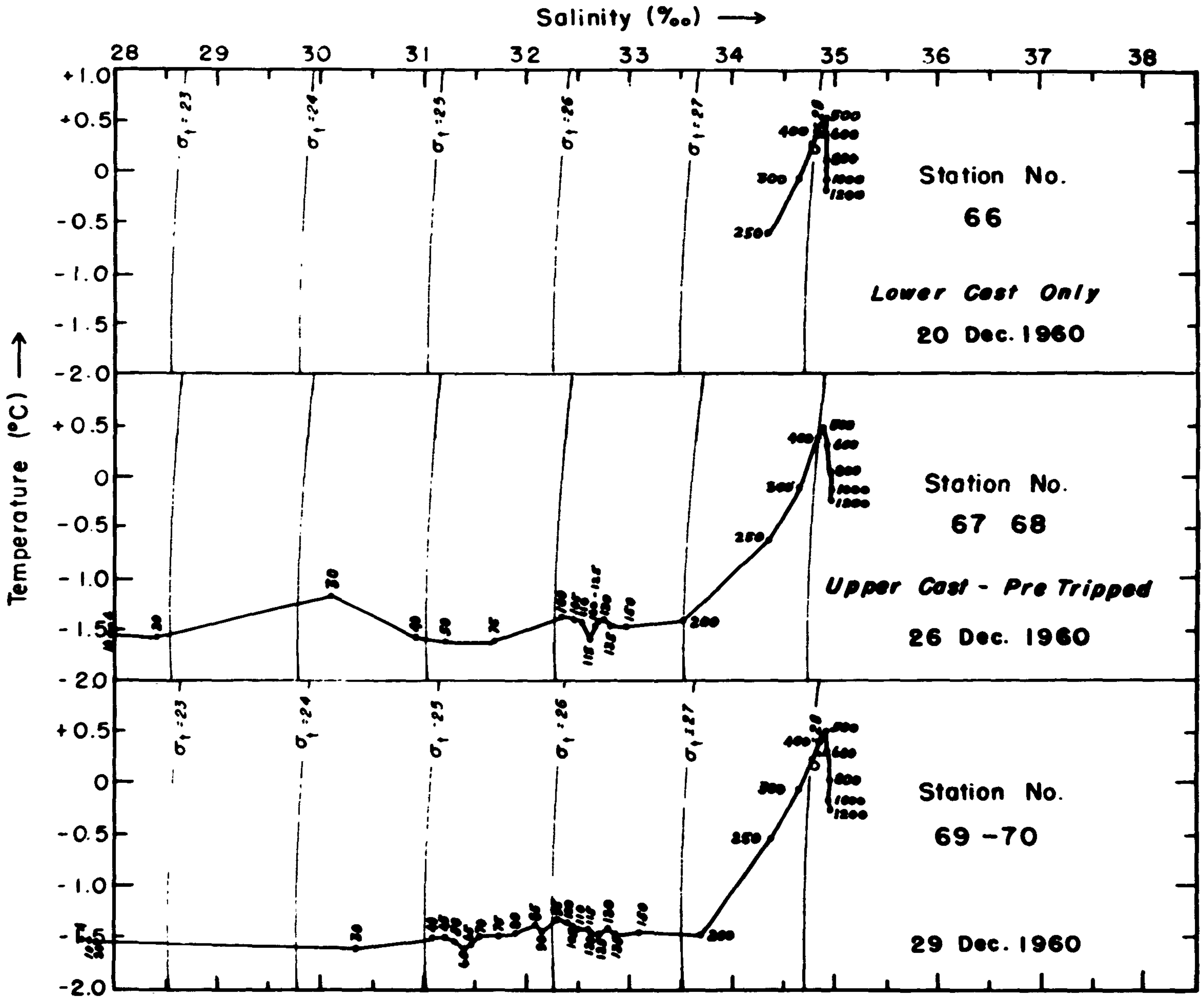

Salinity (‰) ⟶
Temperature (°C) ⟶
Station No. 55 - 56
29 Nov. 1960
Station No. 57 - 58
2 Dec. 1960
Station No. 59 - 60
3 Dec. 1960

T-S DIAGRAMS

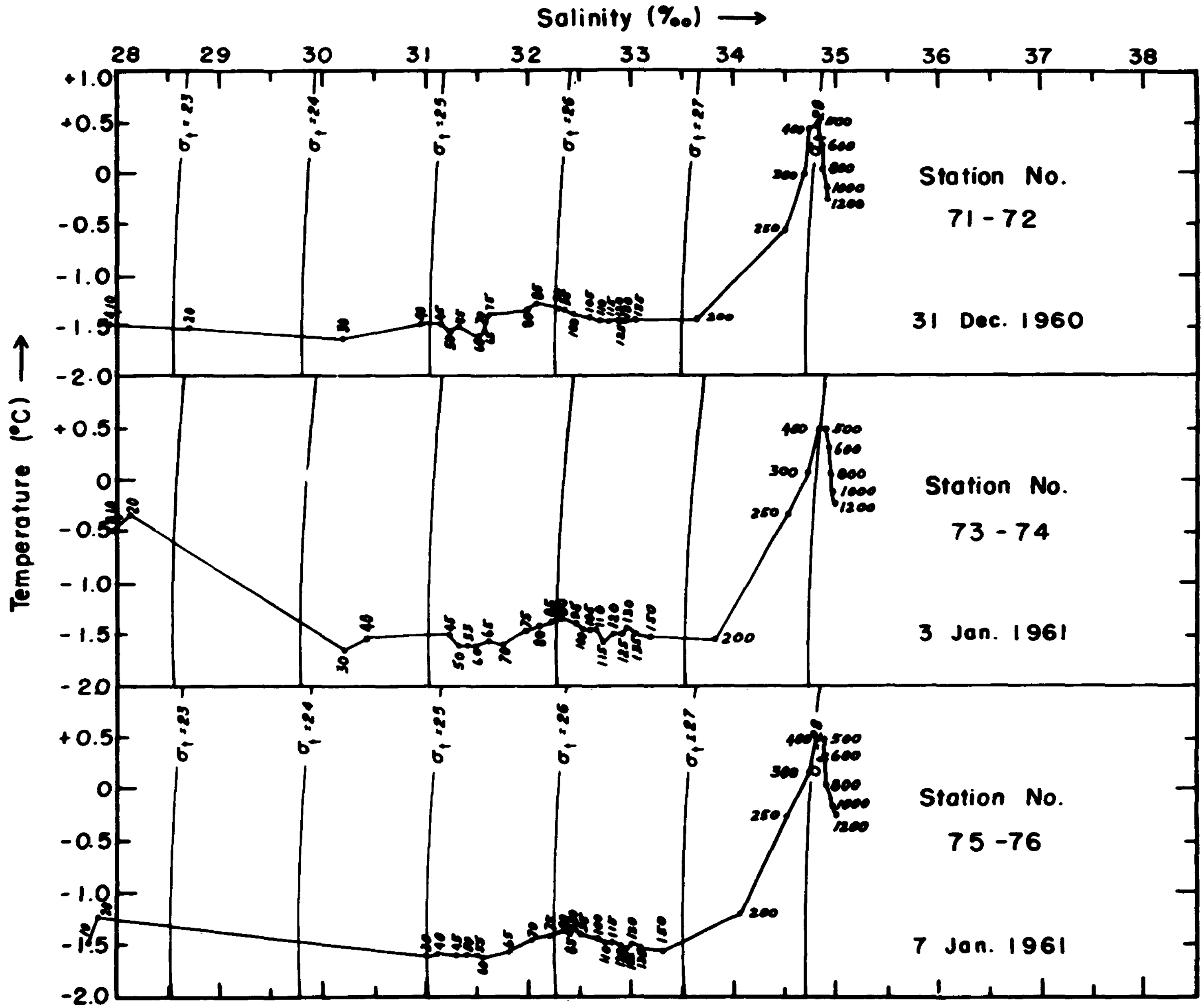


Salinity (‰) →
Temperature (°C) →
Station No. 61
4 Dec. 1960
Station No. 62 + 63
11 Dec. 1960
Station No. 64 + 65
20 Dec. 1960

T-S DIAGRAMS

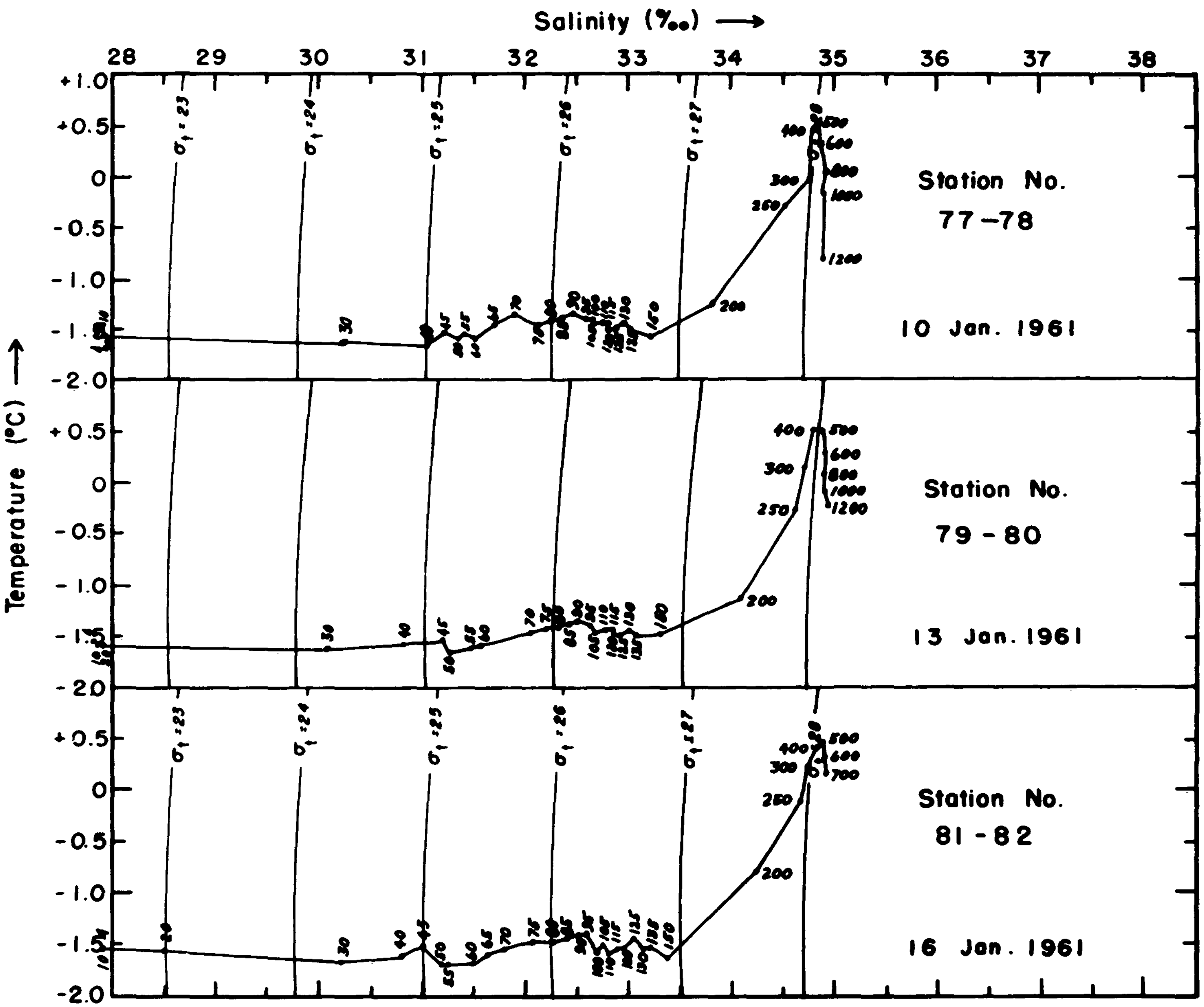

Salinity (‰)
Temperature (°C)
Station No. 66
Lower Cast Only
20 Dec. 1960
Station No. 67 68
Upper Cast - Pre Tripped
26 Dec. 1960
Station No. 69 -70
29 Dec. 1960
σt = 23
σt = 24
σt = 25
σt = 26
σt = 27

T-S DIAGRAMS



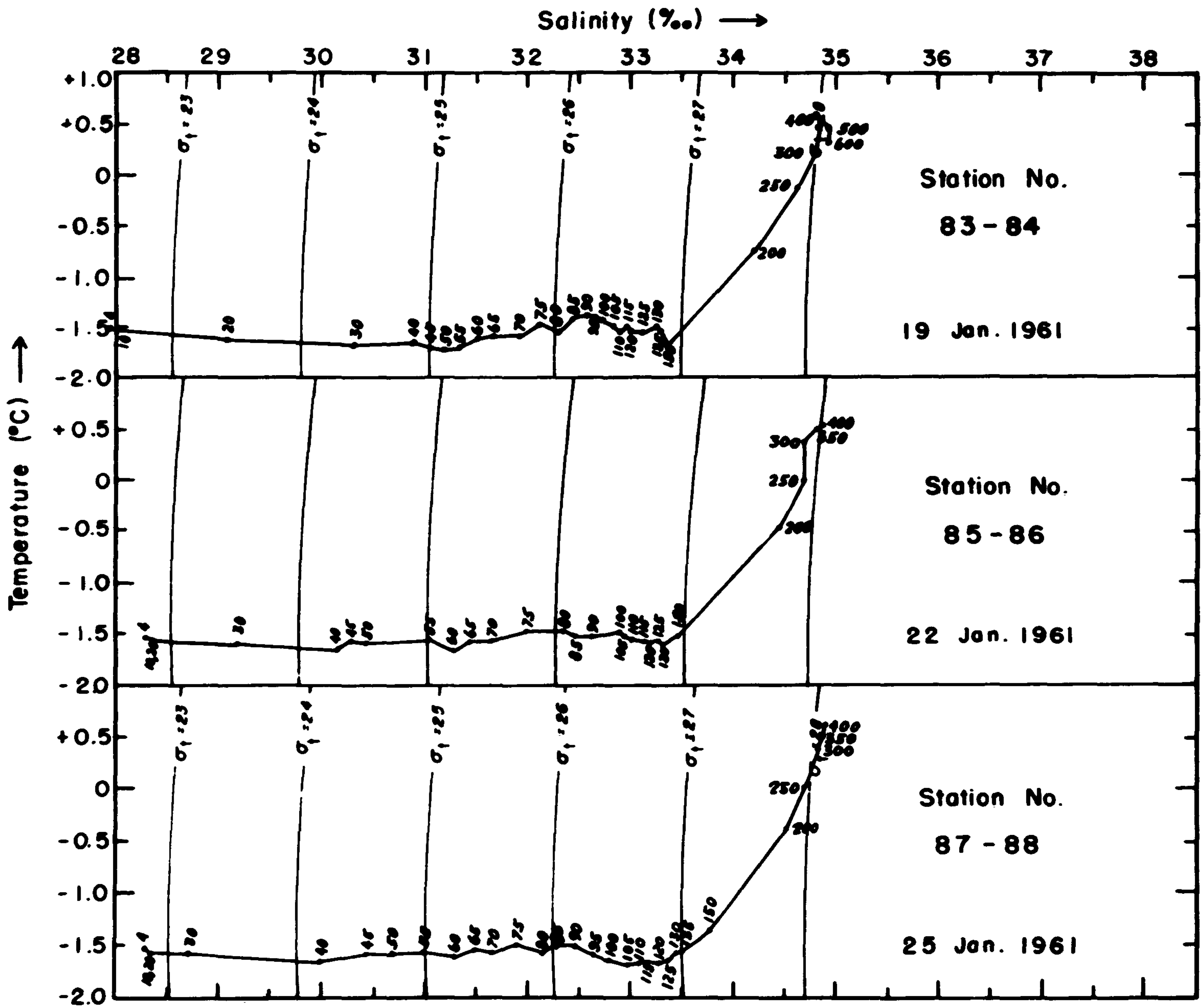
Salinity (‰) →
Temperature (°C) →
Station No.
71 - 72
31 Dec. 1960
Station No.
73 - 74
3 Jan. 1961
Station No.
75 -76
7 Jan. 1961

T-S DIAGRAMS

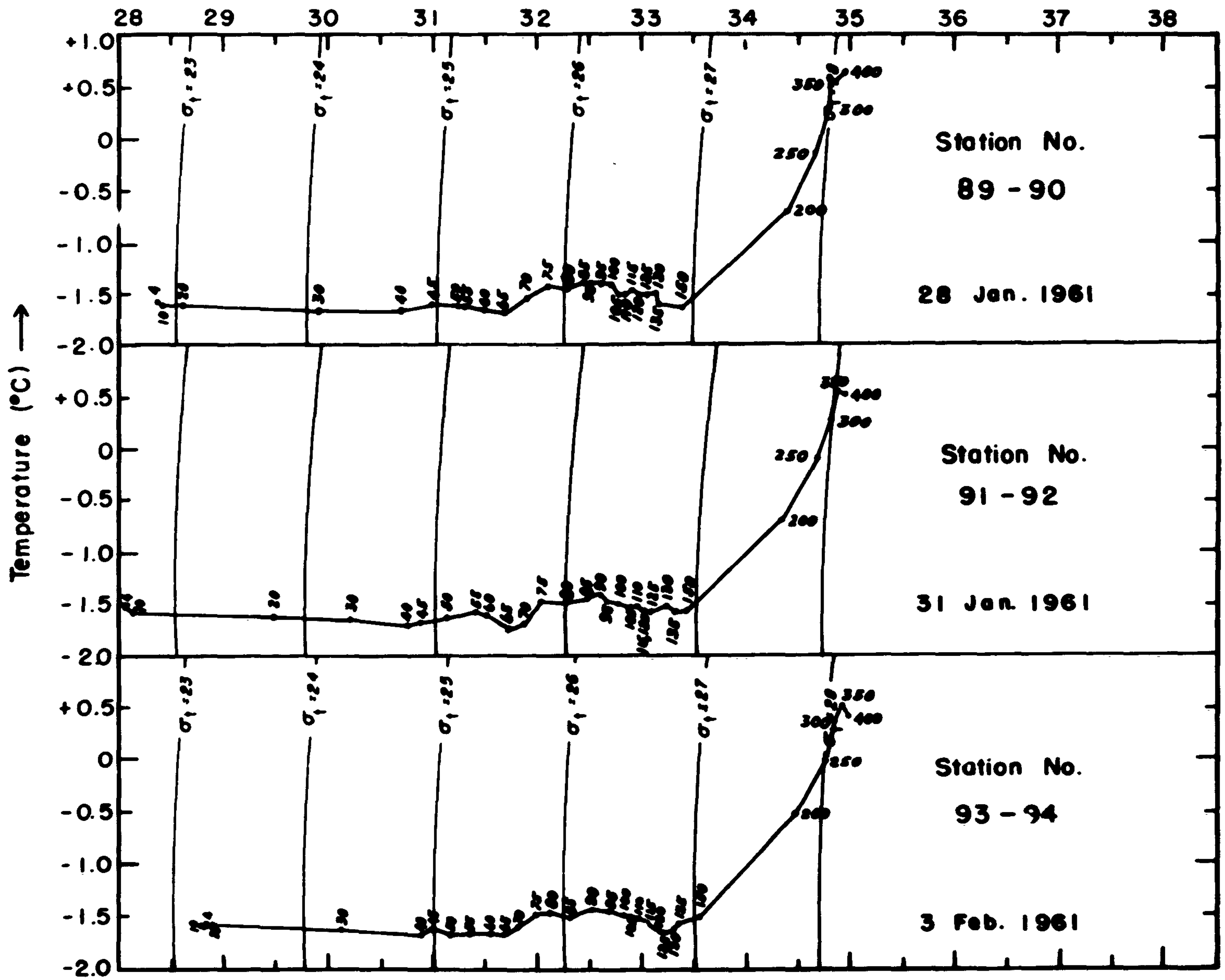


Salinity (‰) ⟶
Temperature (°C) ⟶
Station No. 77–78
10 Jan. 1961
Station No. 79 - 80
13 Jan. 1961
Station No. 81 - 82
16 Jan. 1961
σt = 23
σt = 24
σt = 25
σt = 26
σt = 27

T-S DIAGRAMS

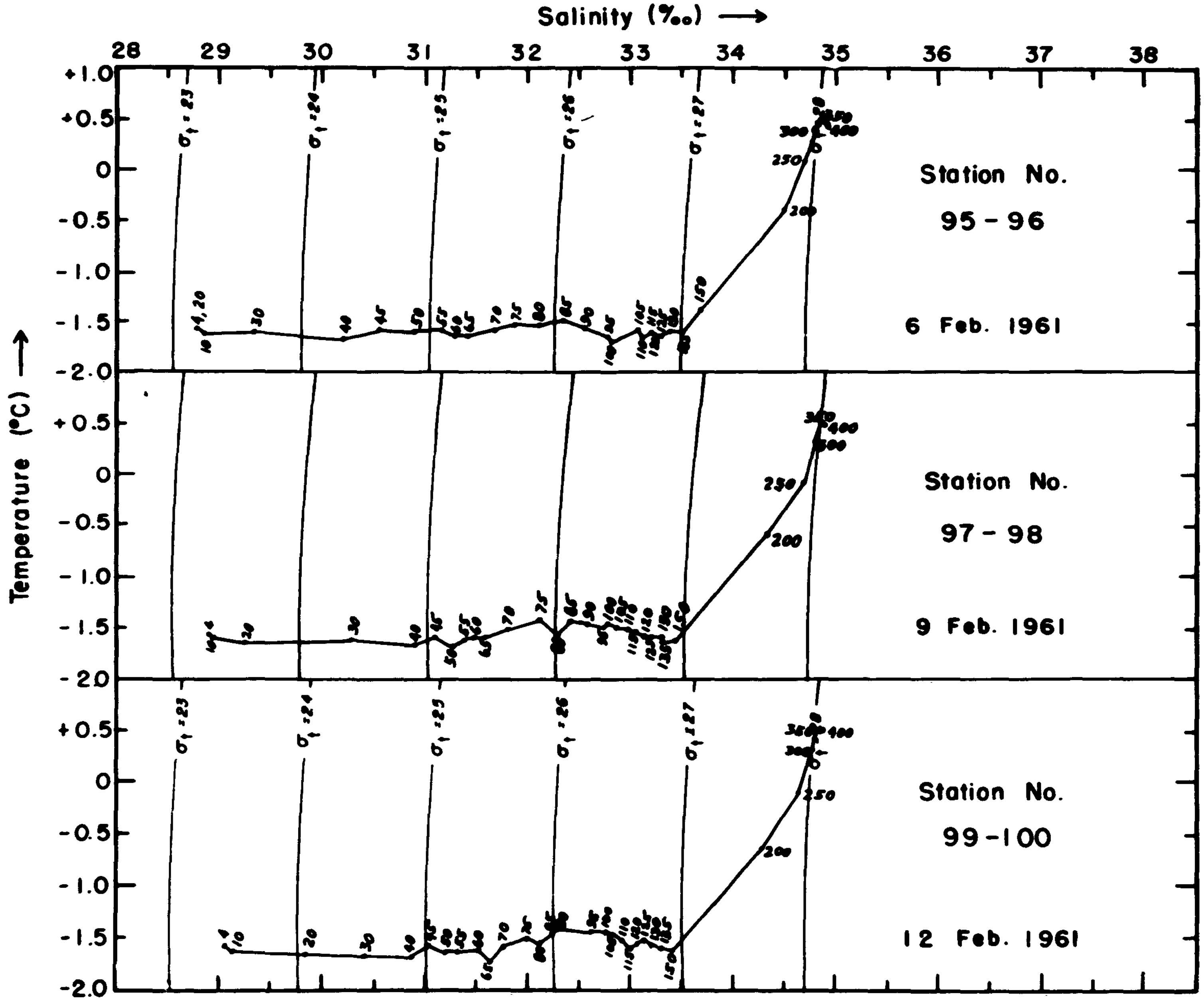

Salinity (‰) →
Temperature (°C) →
Station No.
83 - 84
19 Jan. 1961
Station No.
85 - 86
22 Jan. 1961
Station No.
87 - 88
25 Jan. 1961

T-S DIAGRAMS

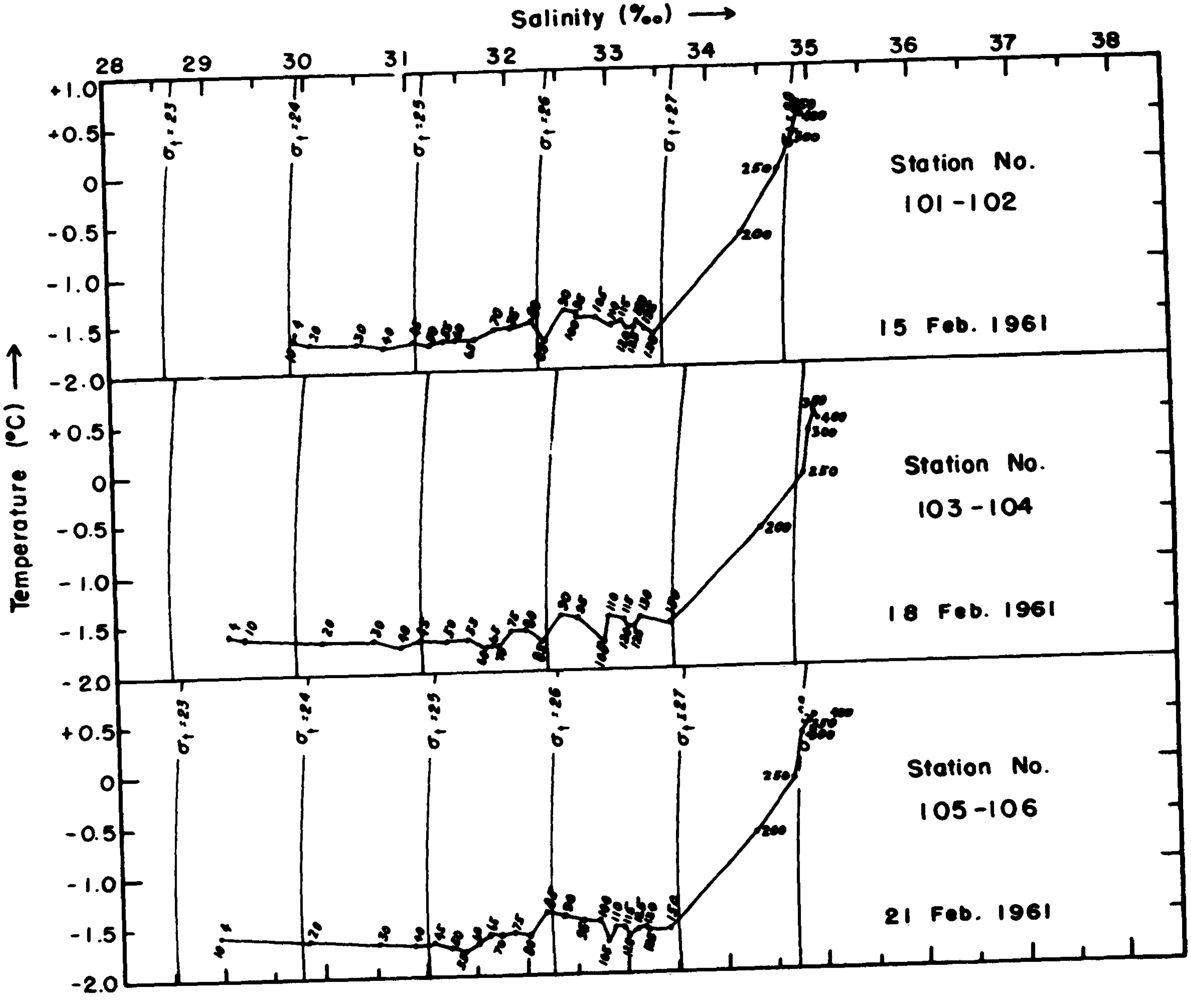


Salinity (‰)
Temperature (°C)
Station No.
89 - 90
28 Jan. 1961
Station No.
91 - 92
31 Jan. 1961
Station No.
93 - 94
3 Feb. 1961

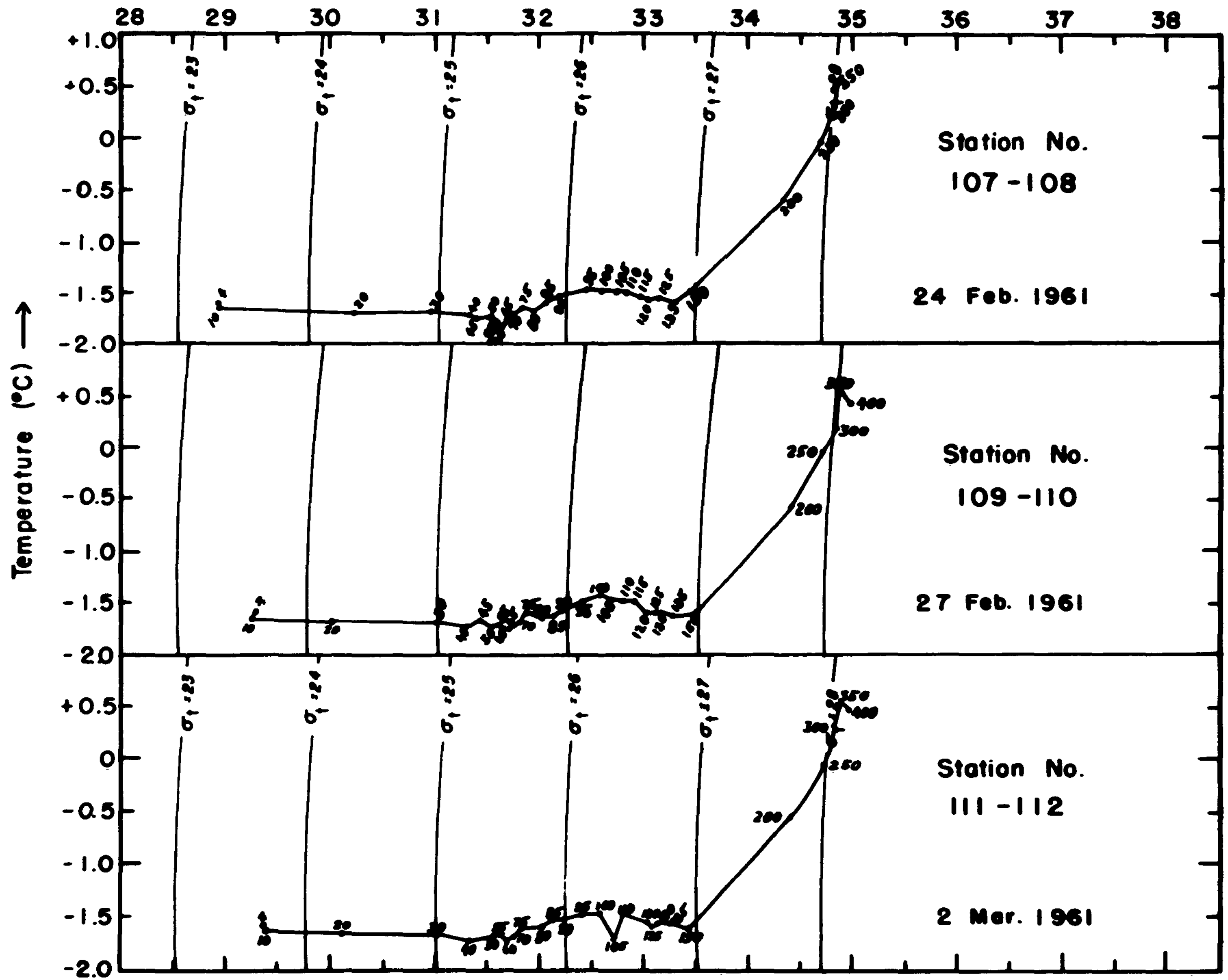
T-S DIAGRAMS


Salinity (‰) →
Temperature (°C) →
Station No.
95 - 96
6 Feb. 1961
Station No.
97 - 98
9 Feb. 1961
Station No.
99-100
12 Feb. 1961

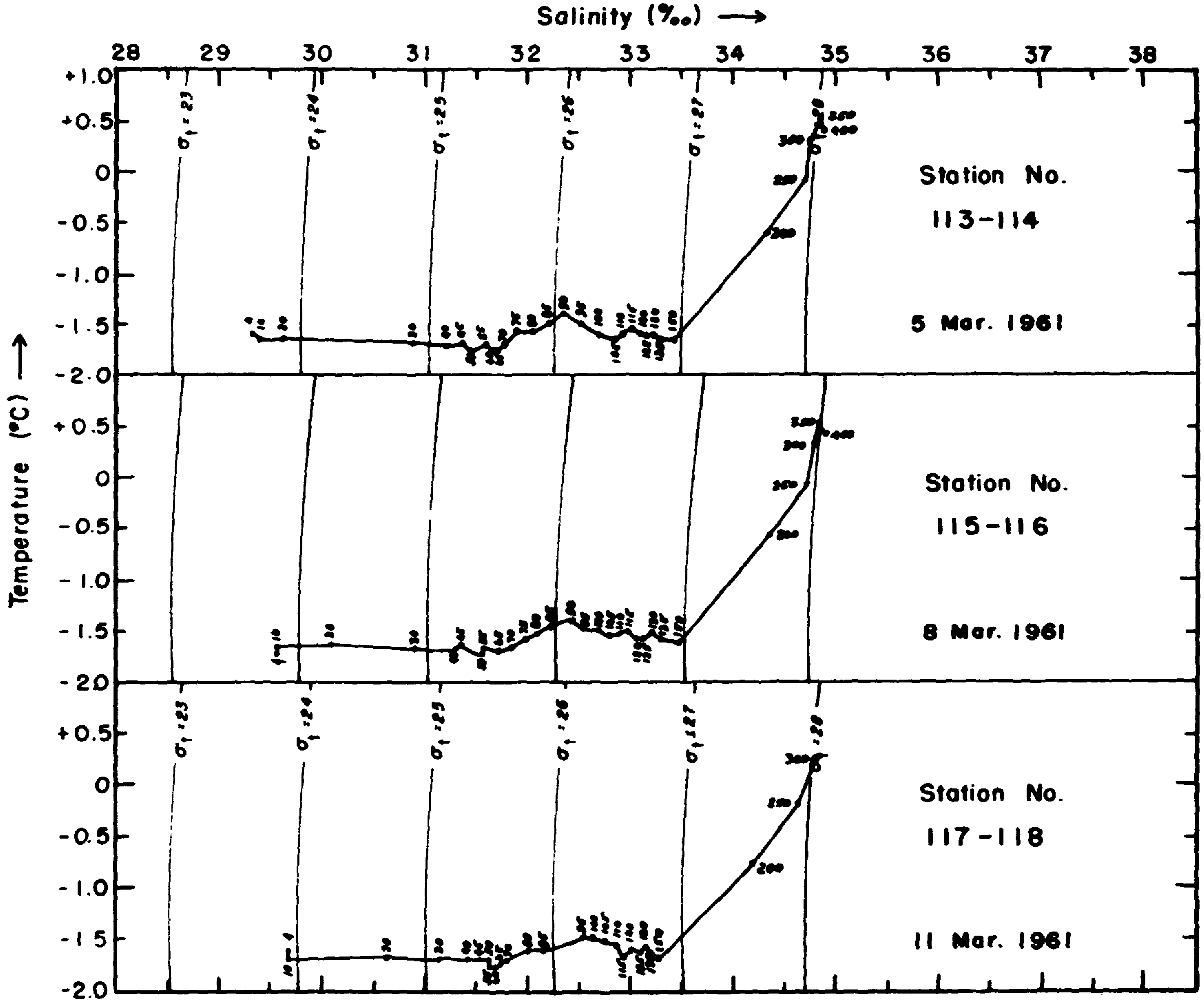
T-S DIAGRAMS

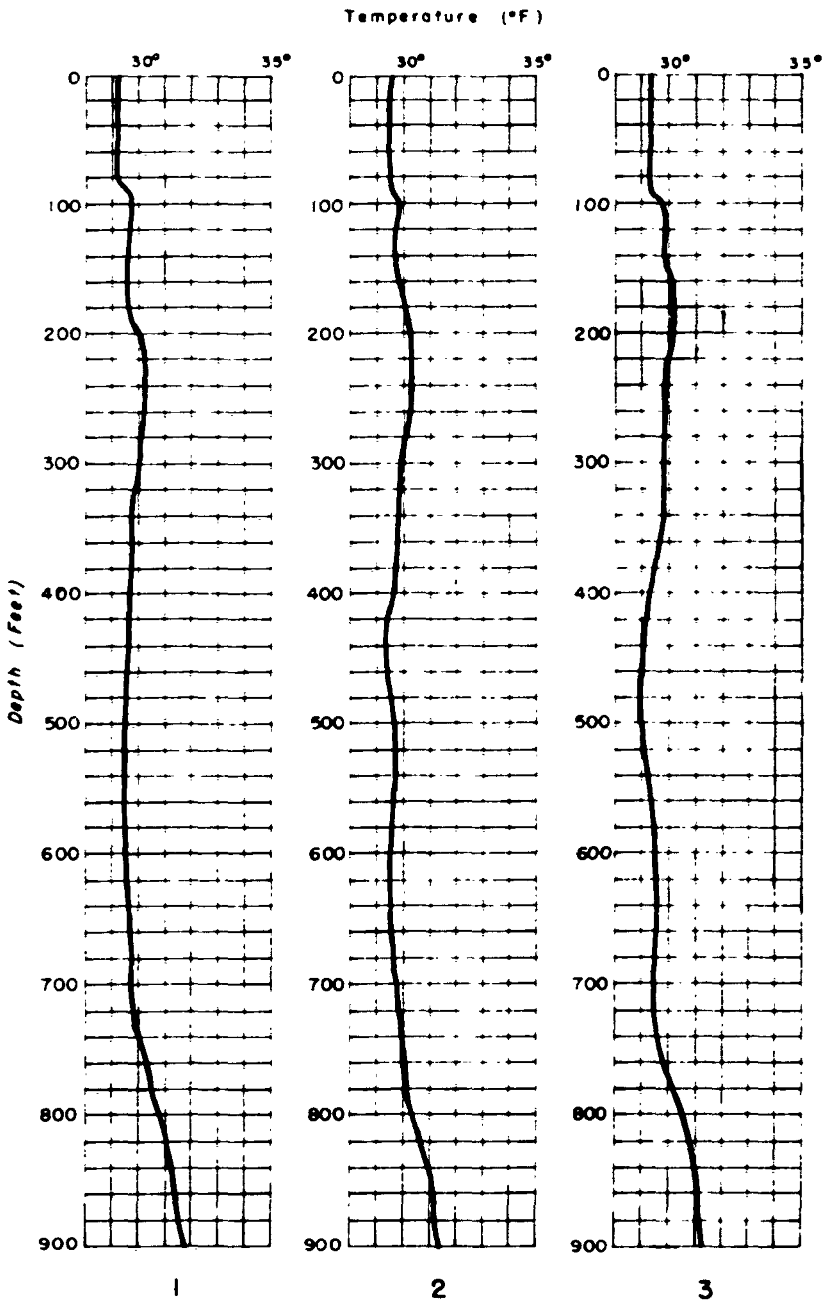

Salinity (‰) →
Temperature (°C) →
Station No.
101-102
15 Feb. 1961
Station No.
103-104
18 Feb. 1961
Station No.
105-106
21 Feb. 1961

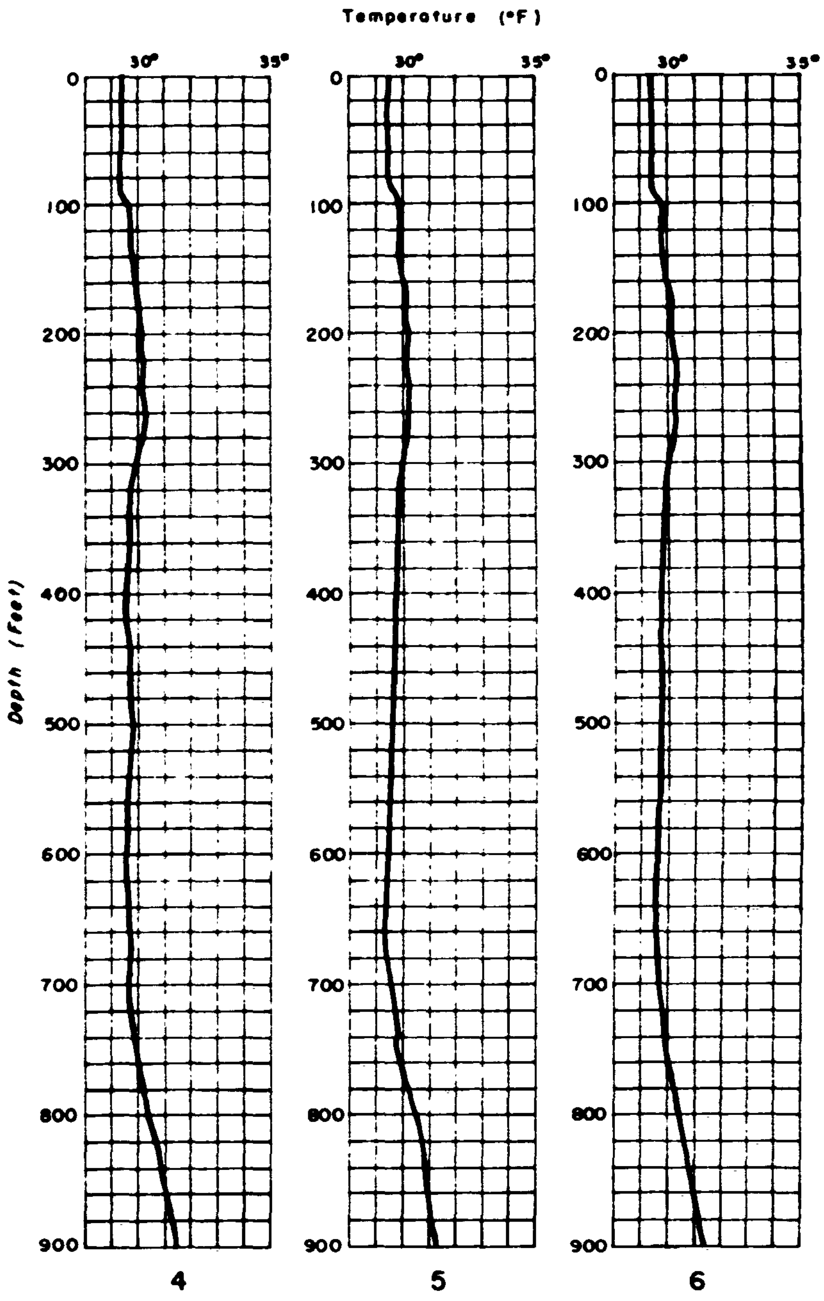
T-S DIAGRAMS

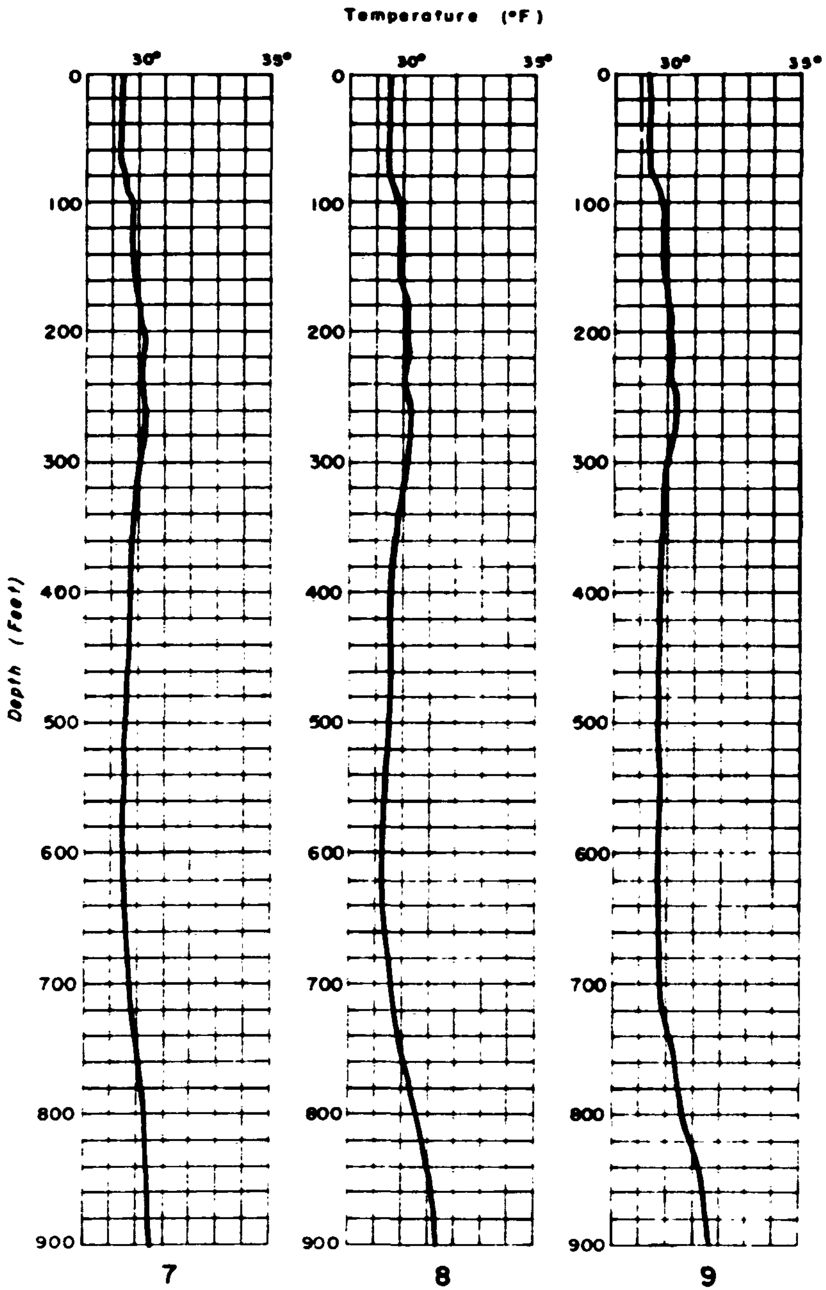

Salinity (‰) →
Temperature (°C) →
Station No.
107 - 108
24 Feb. 1961
Station No.
109 - 110
27 Feb. 1961
Station No.
111 - 112
2 Mar. 1961

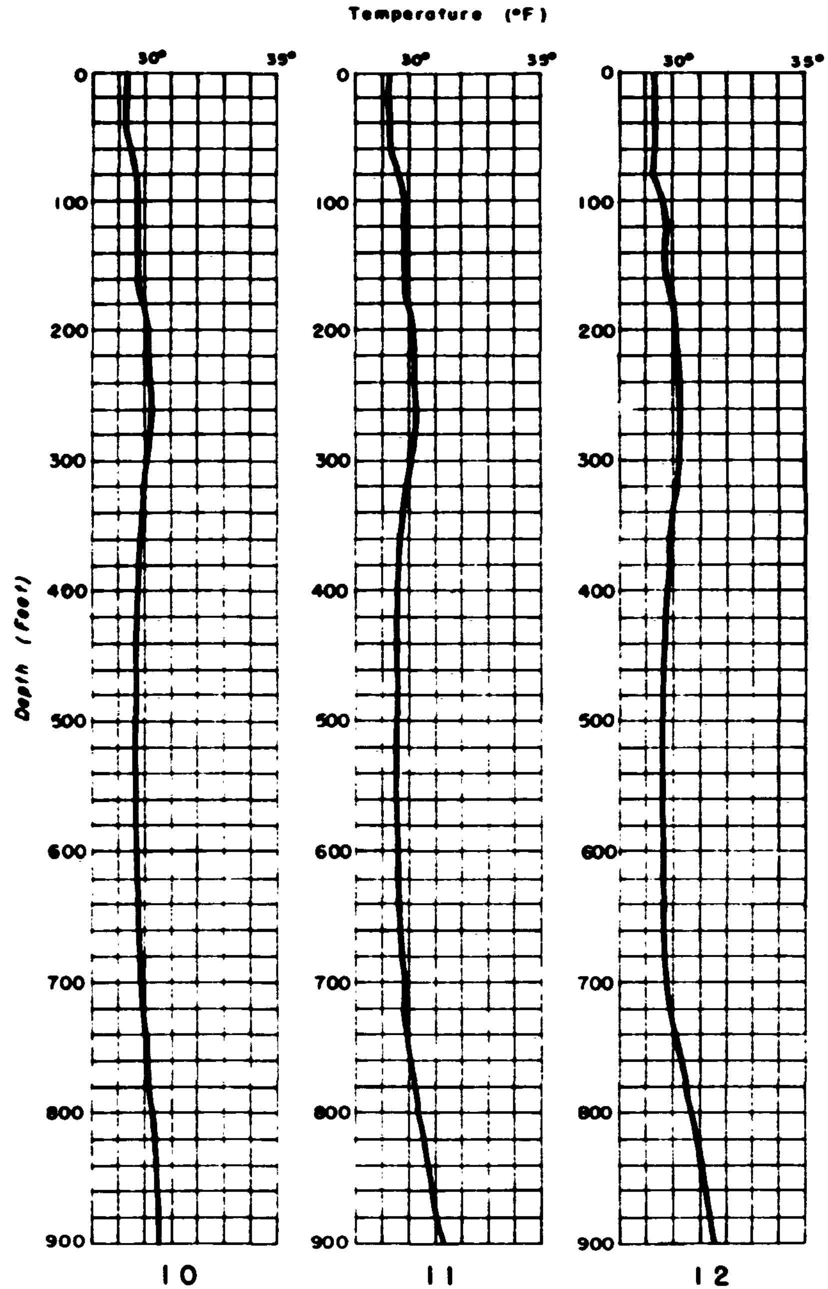
T-S DIAGRAMS

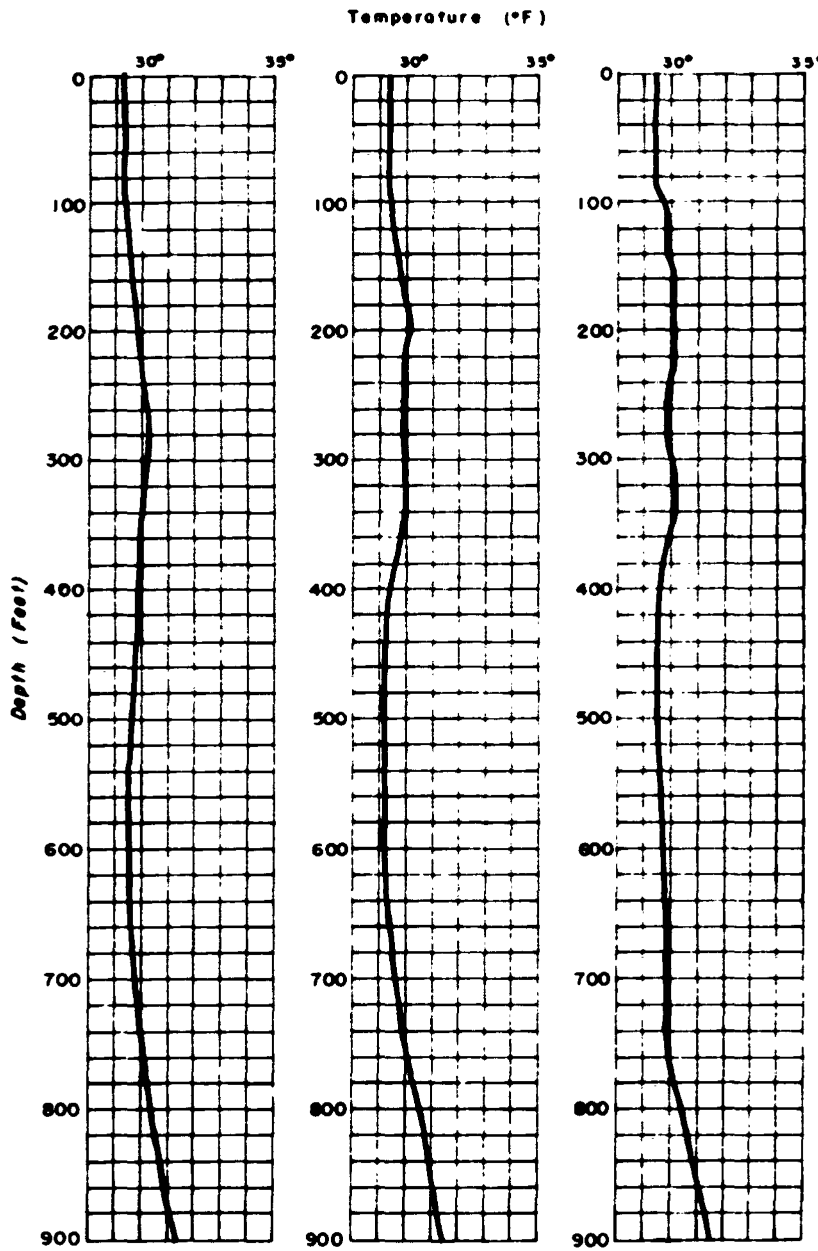

Salinity (‰) →
Temperature (°C) →
Station No.
113-114
5 Mar. 1961
Station No.
115-116
8 Mar. 1961
Station No.
117-118
11 Mar. 1961
$\sigma_t = 23$
$\sigma_t = 24$
$\sigma_t = 25$
$\sigma_t = 26$
$\sigma_t = 27$
$\sigma_t = 28$


Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
1
2
3

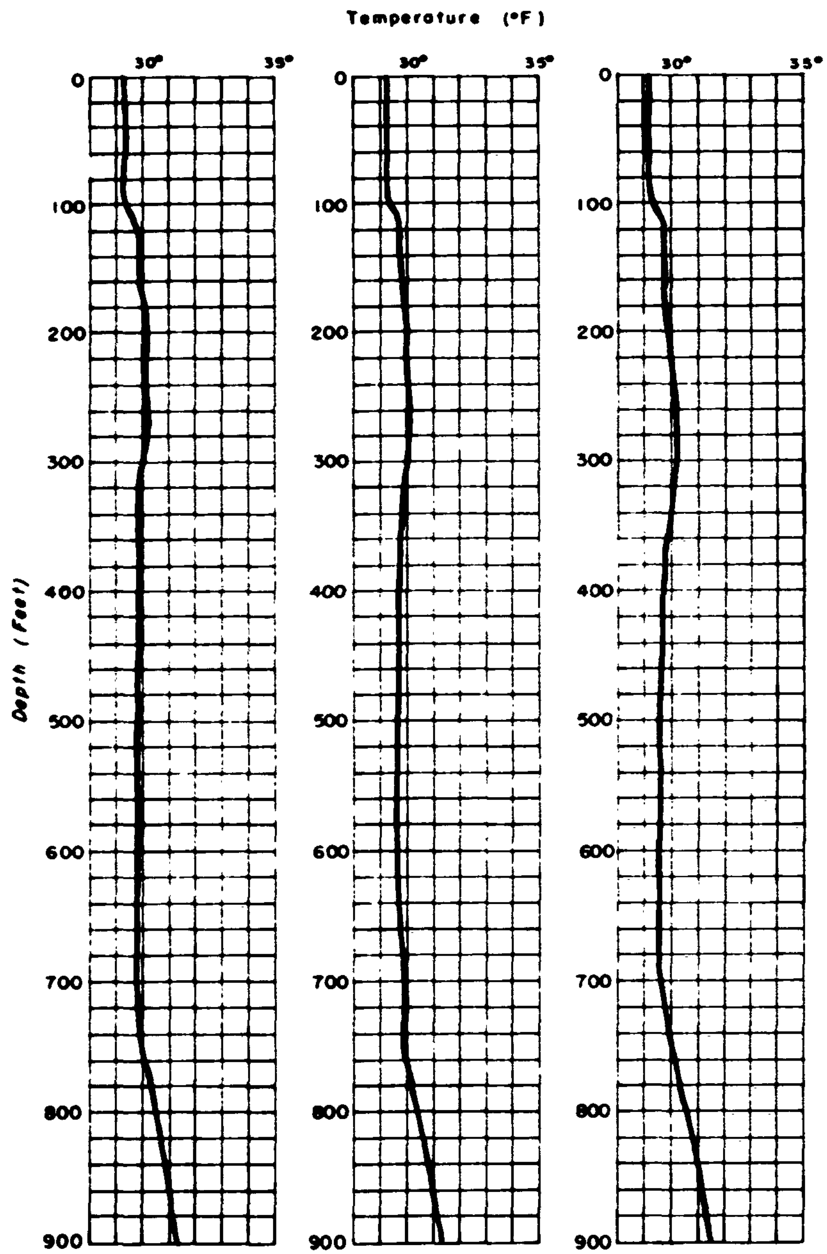

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
4
5
6


Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
7
8
9

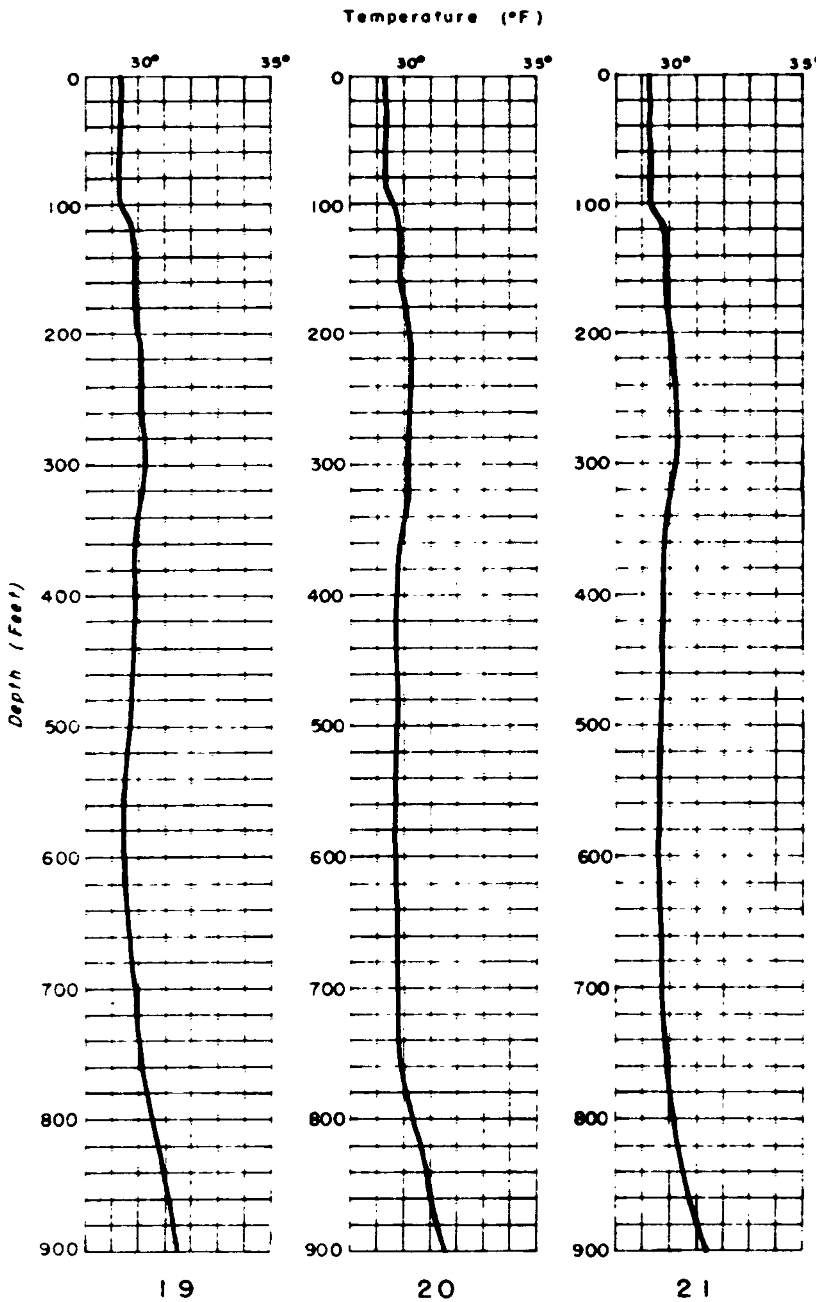

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
10
11
12

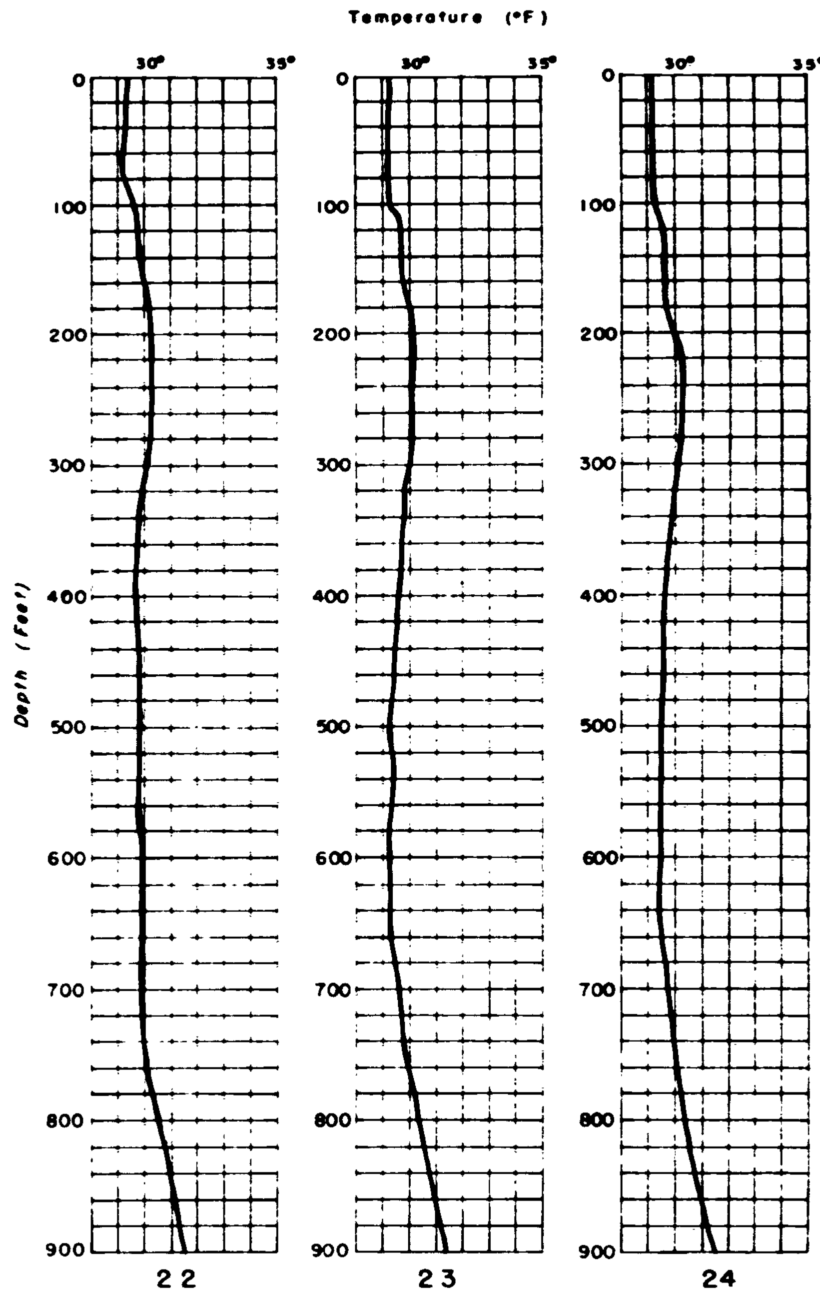


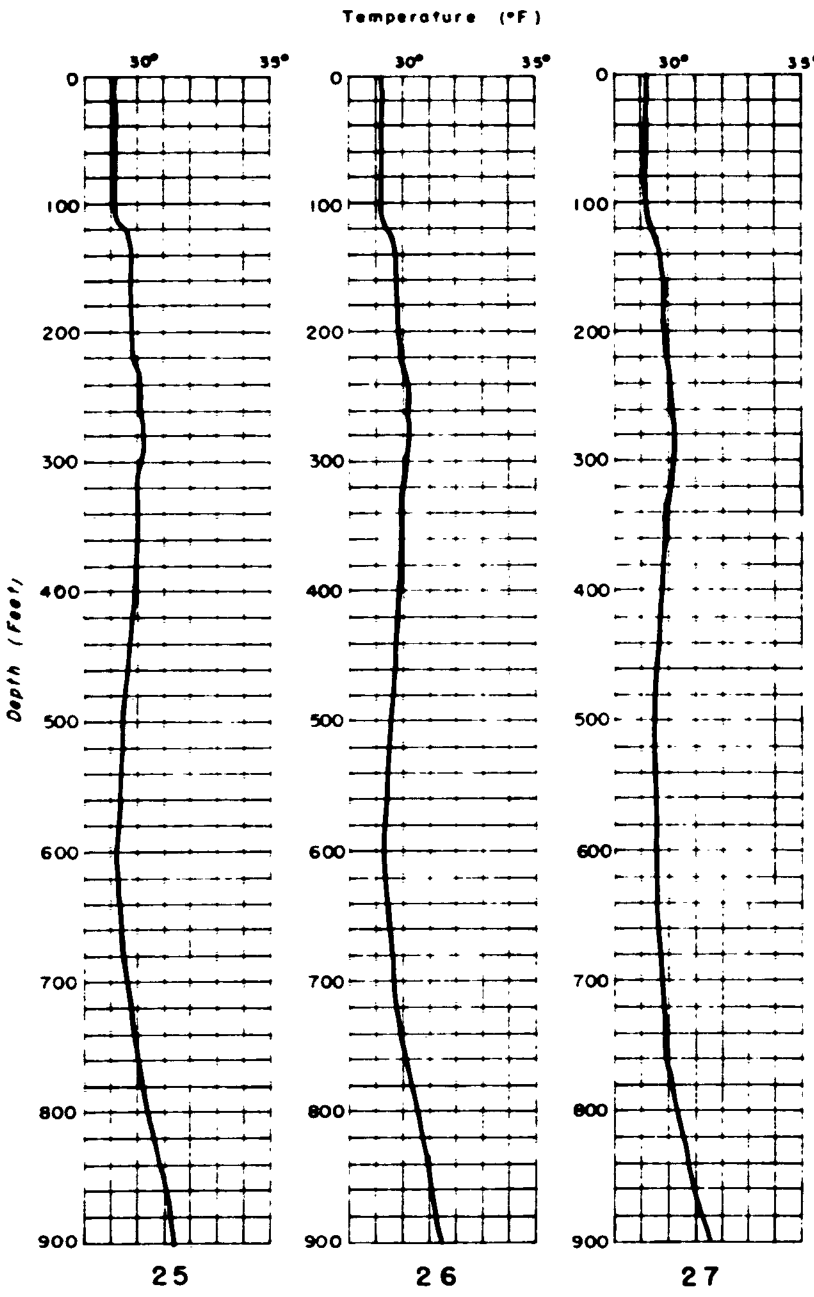
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
13
14
15



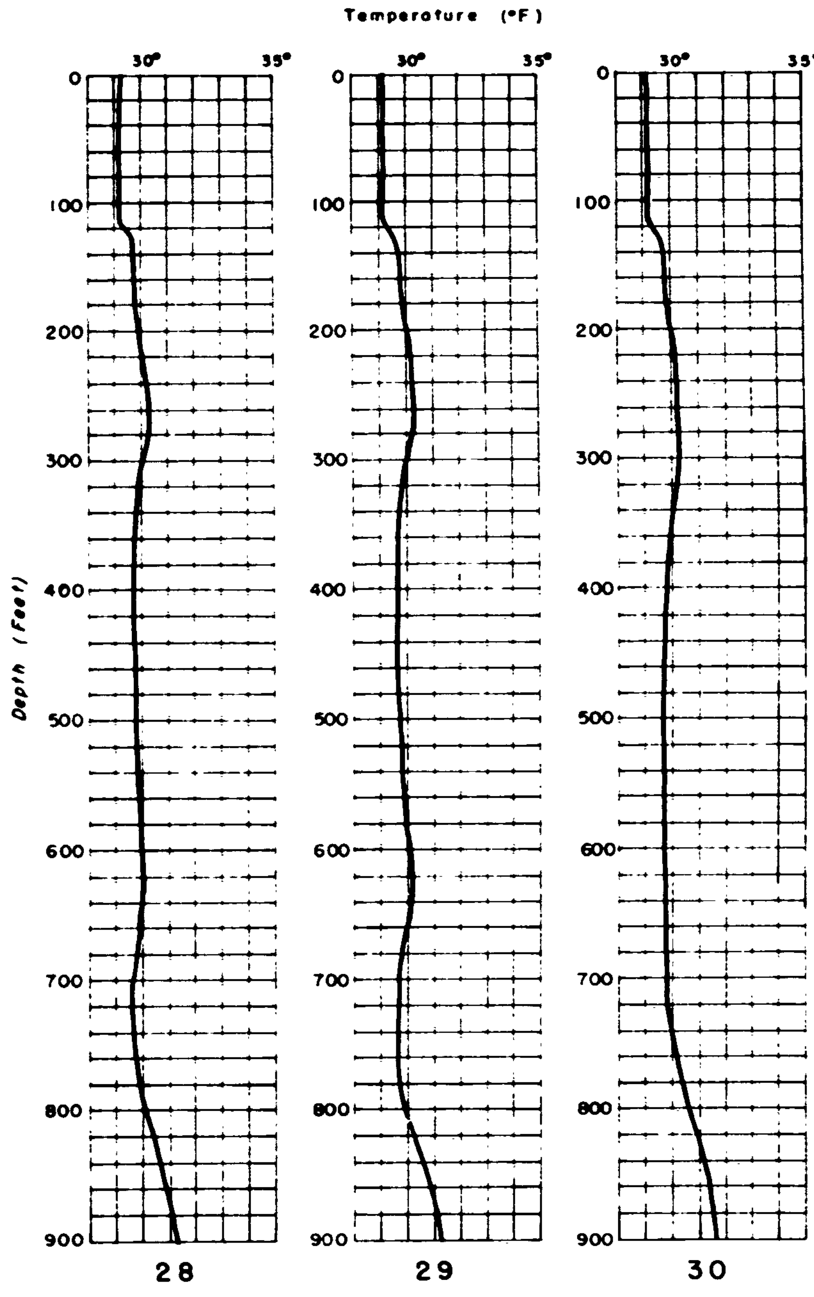
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
16
17
18


Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
19
20
21

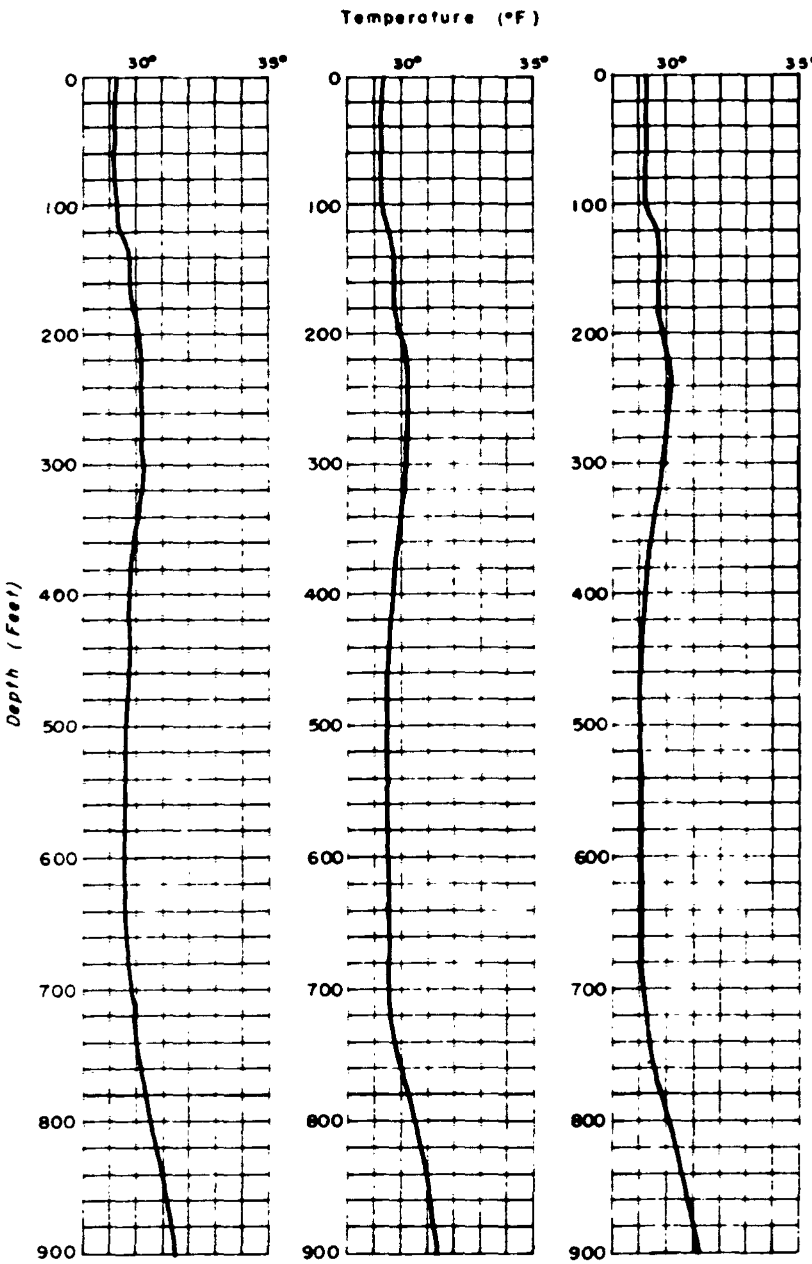

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
22
23
24



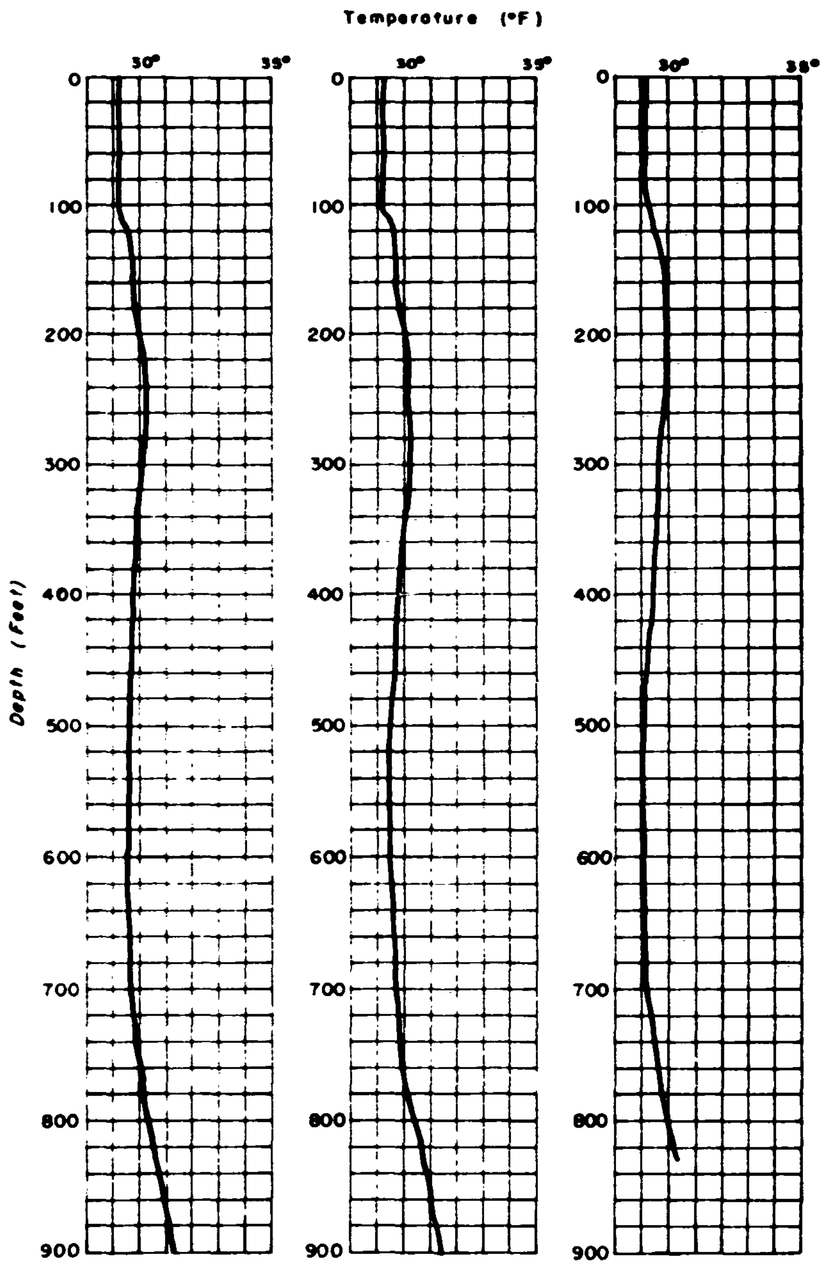
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
25
26
27



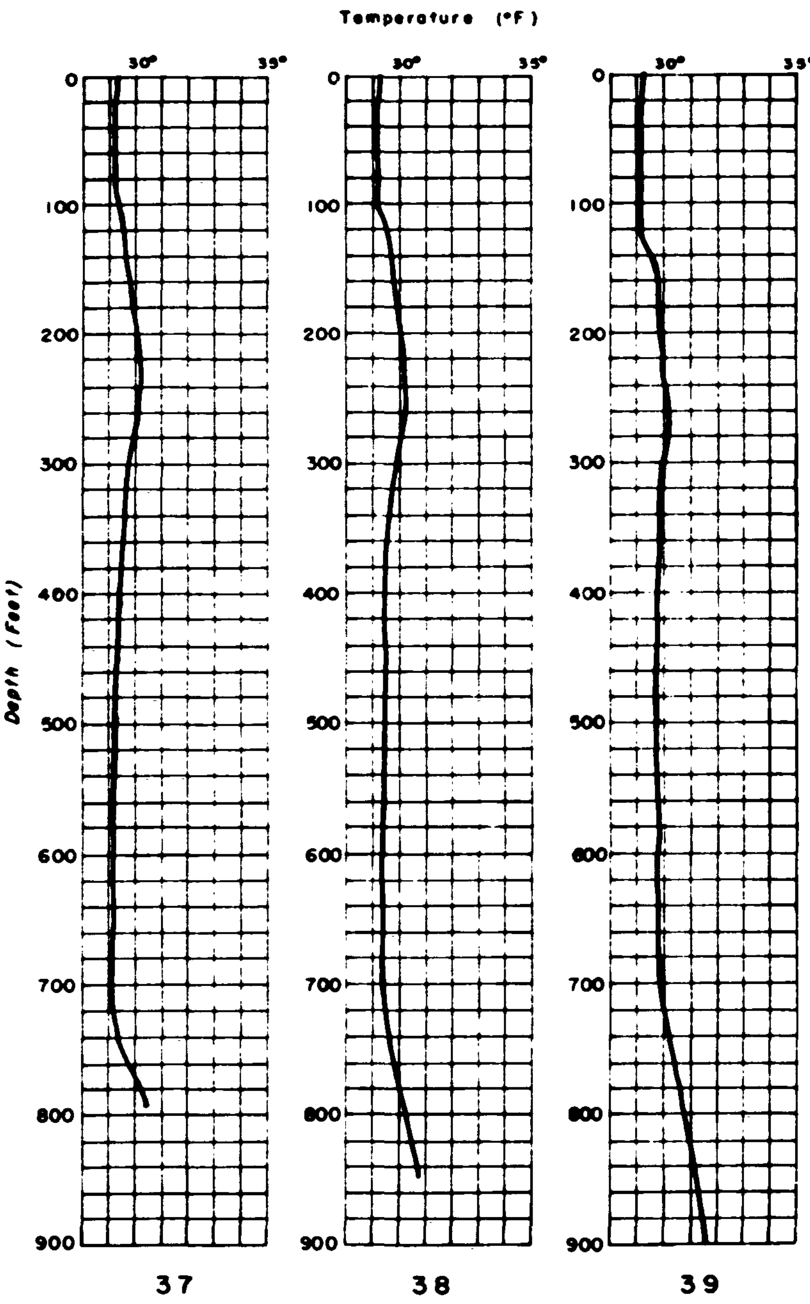
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
28
29
30

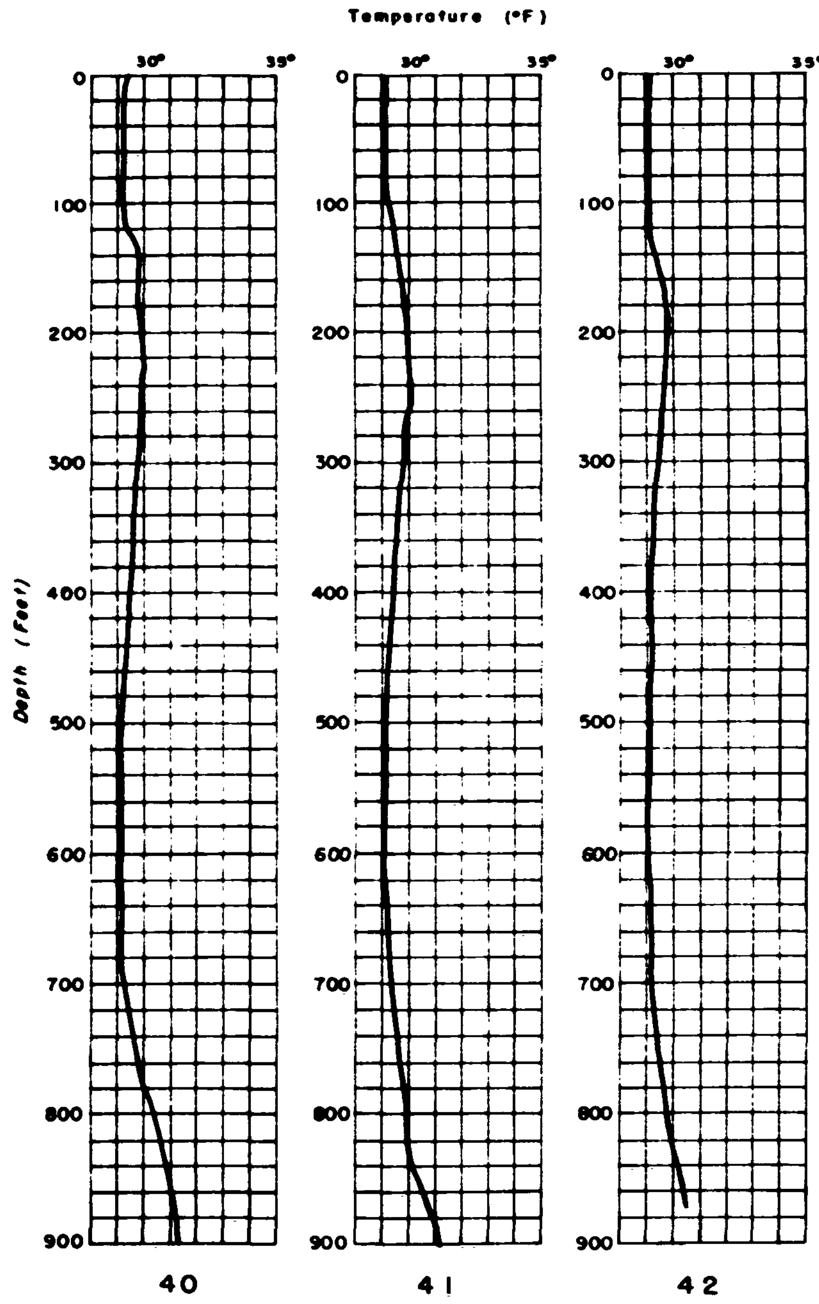


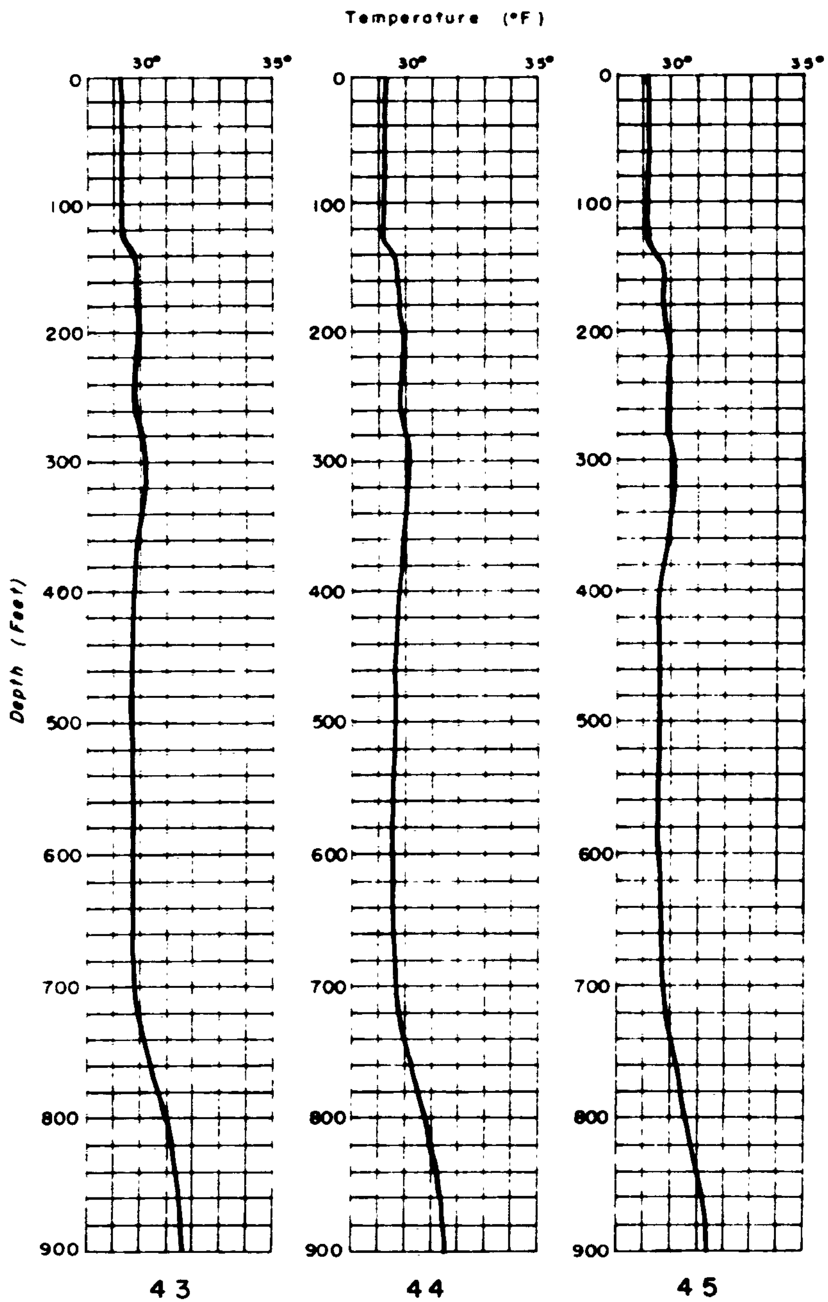
31 32 33

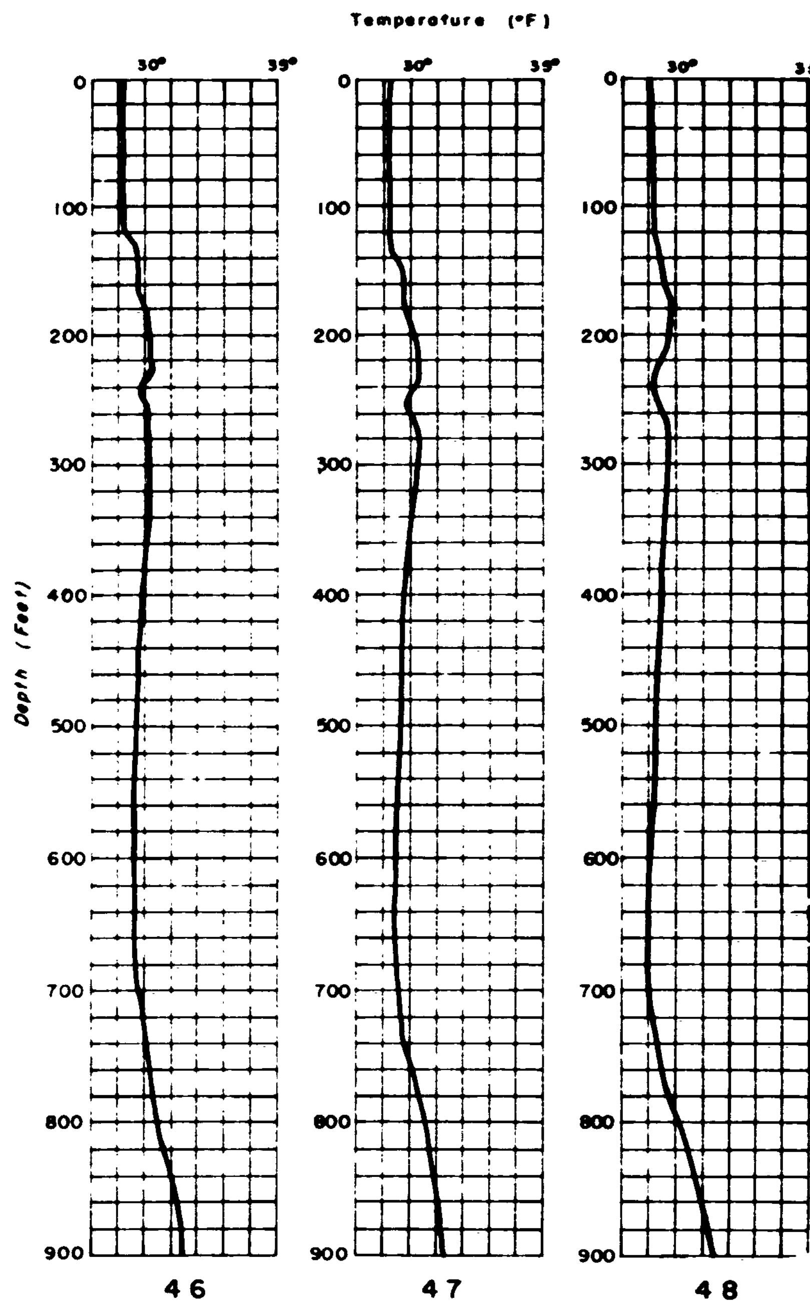


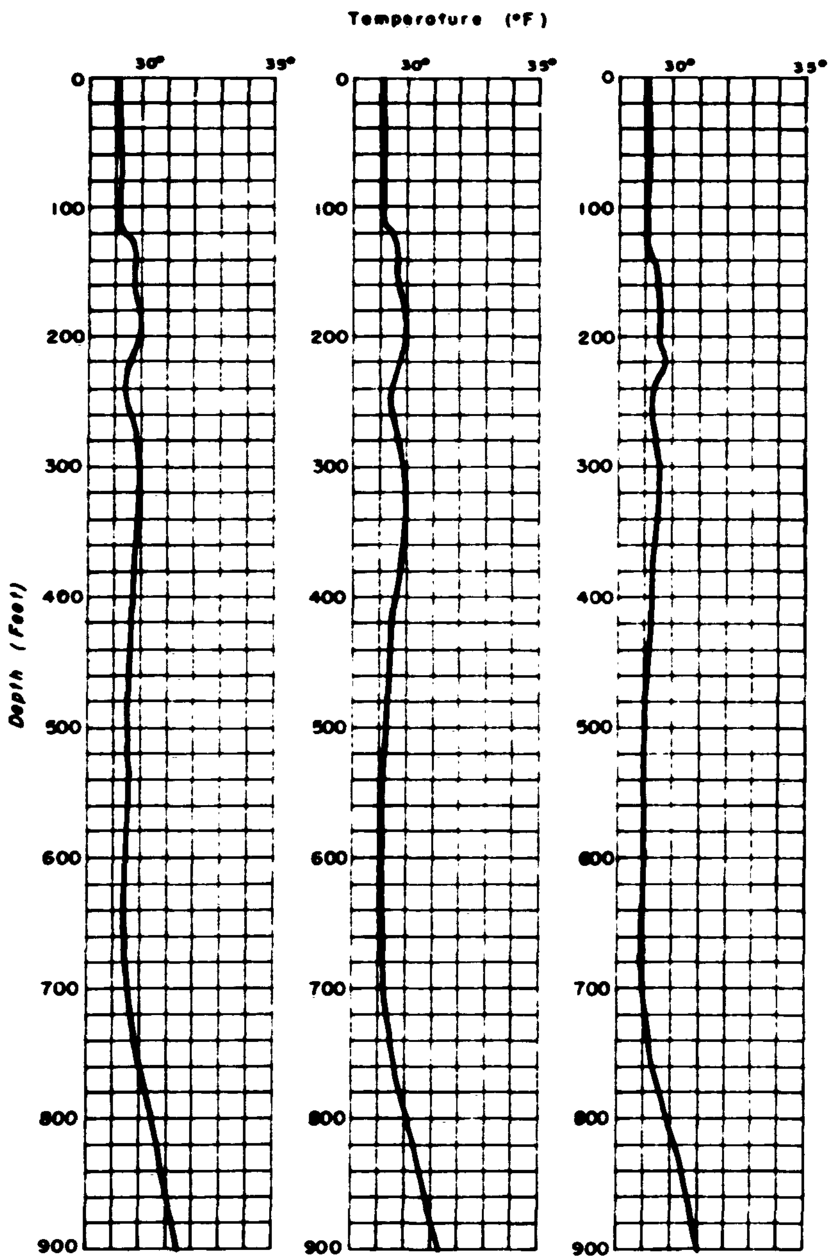
34 35 36


Temperature (°F)
Depth (Feet)
37
38
39

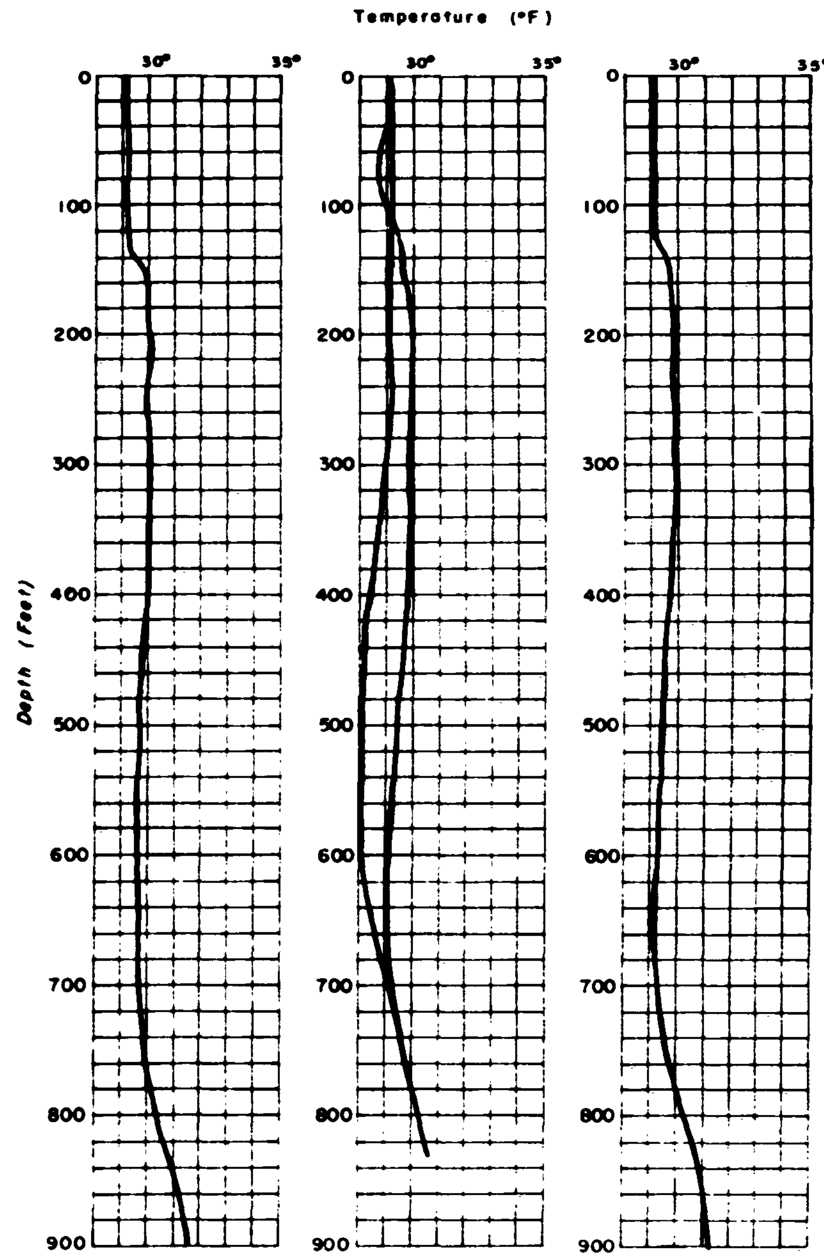

Temperature (°F)
Depth (Feet)
40
41
42


Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
43
44
45

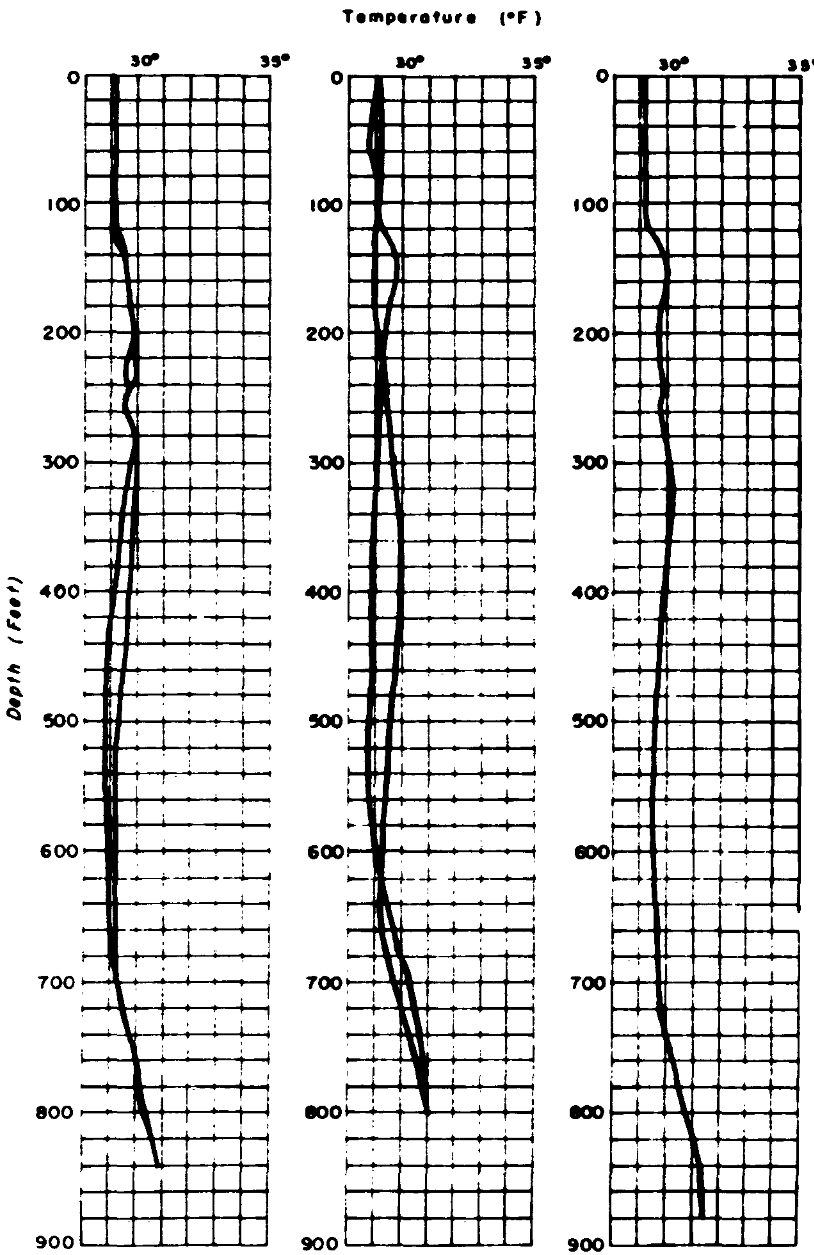

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
46
47
48



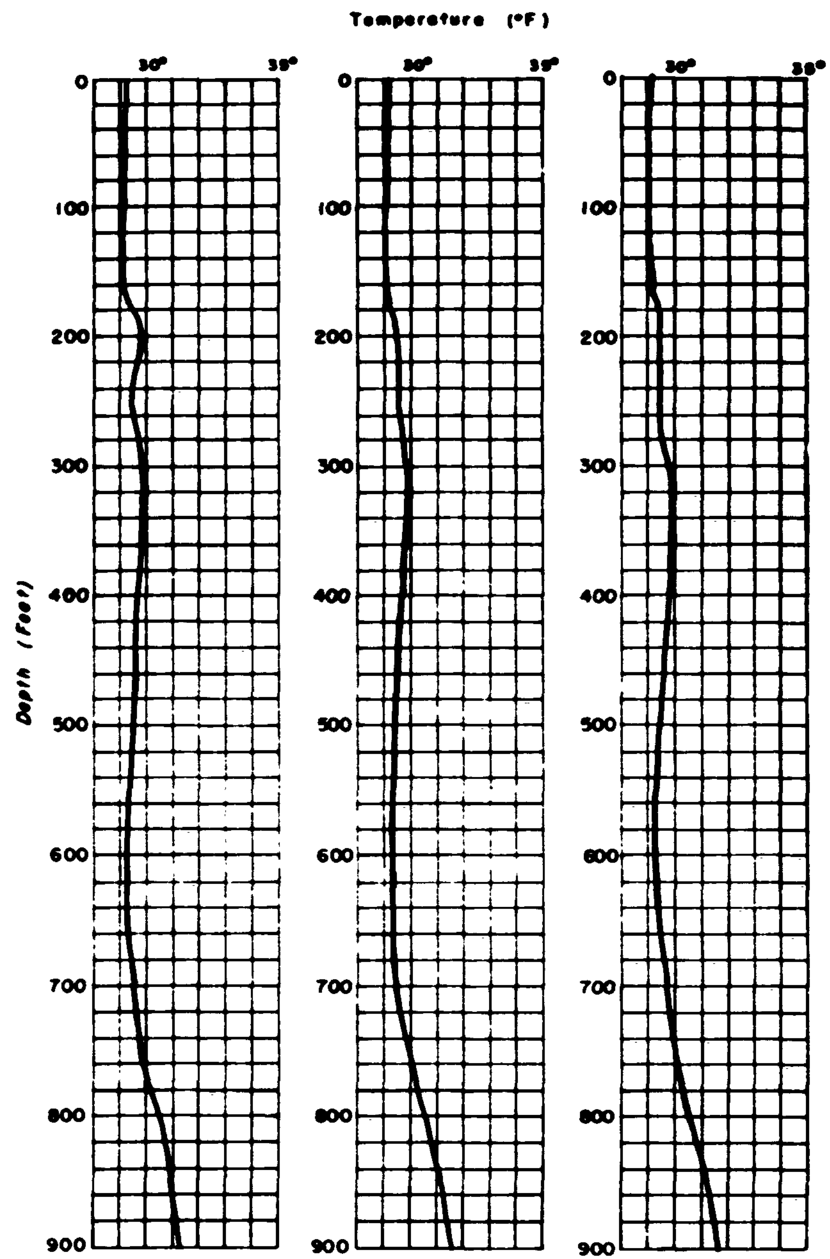
49 50 51



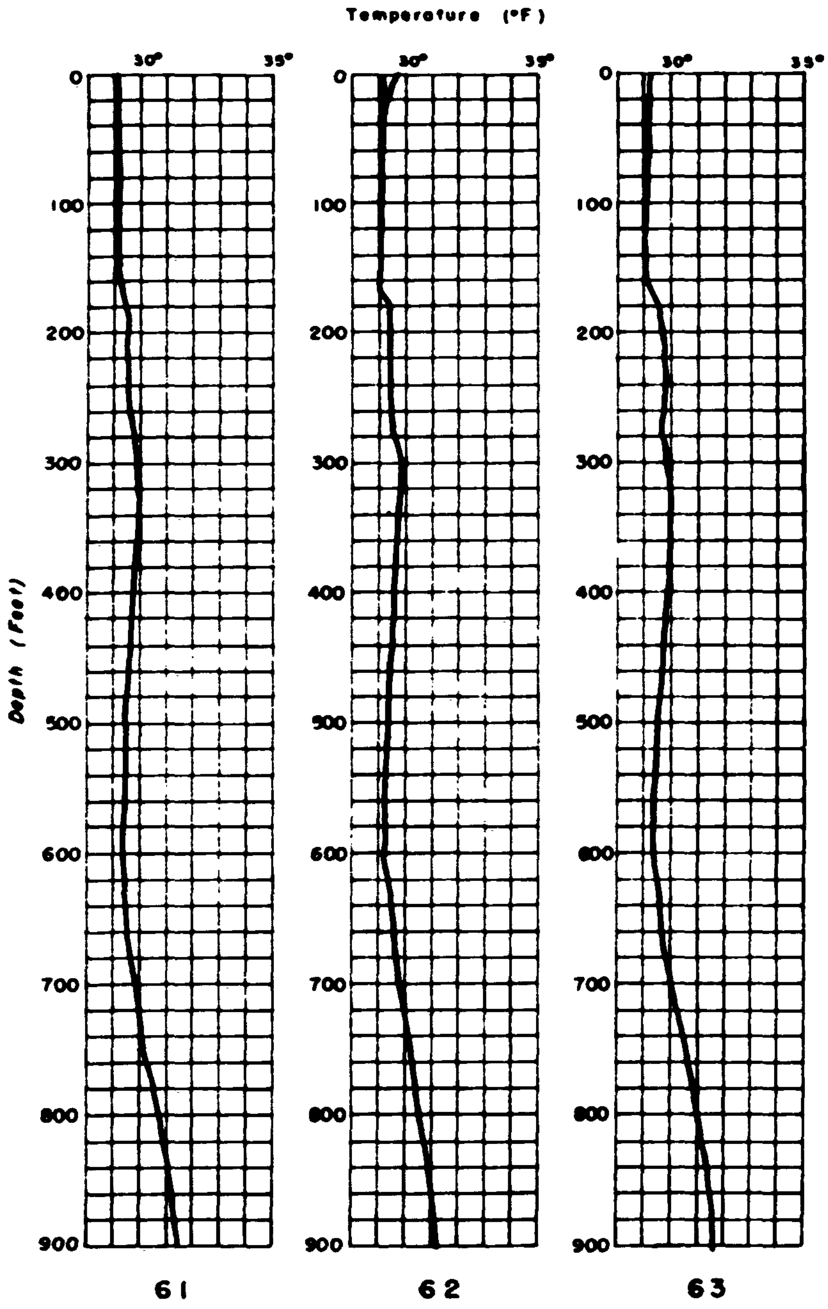
52 53 54

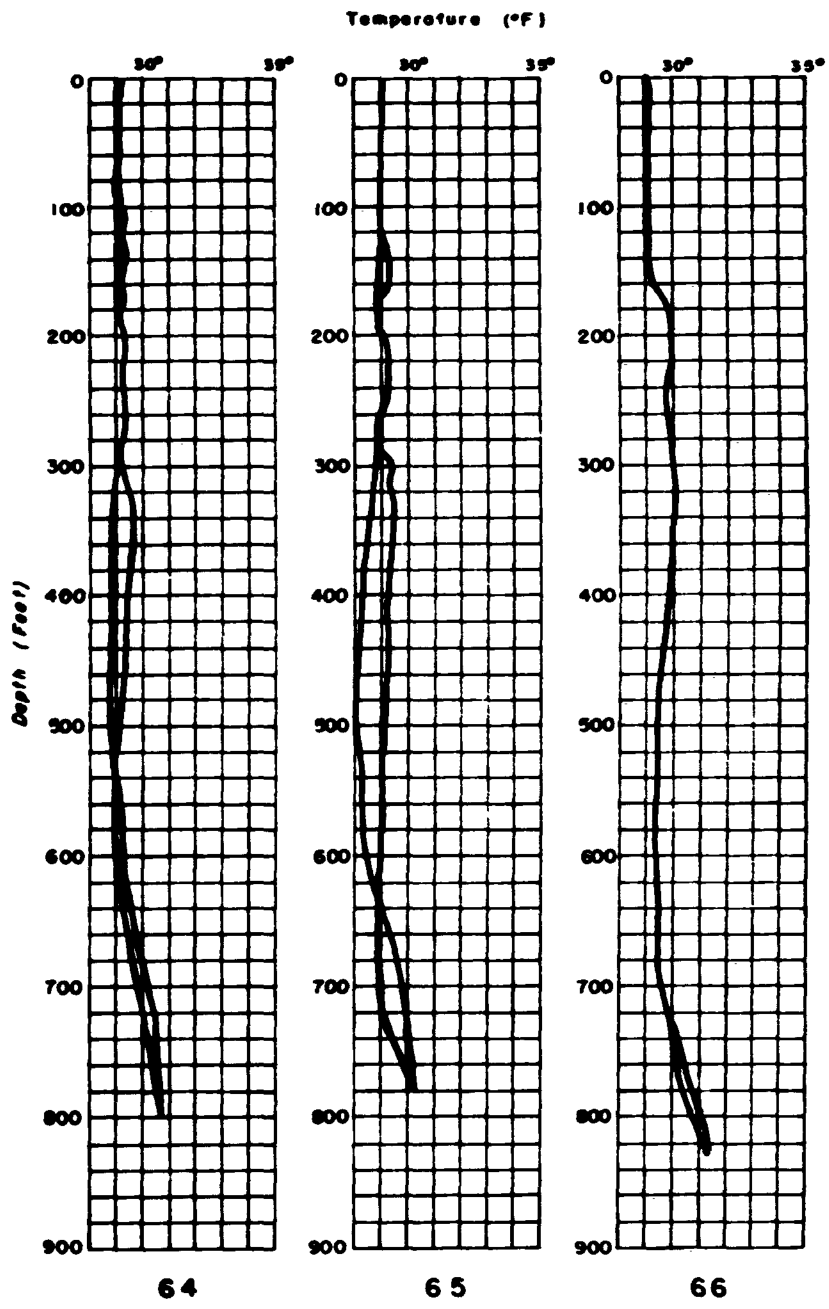


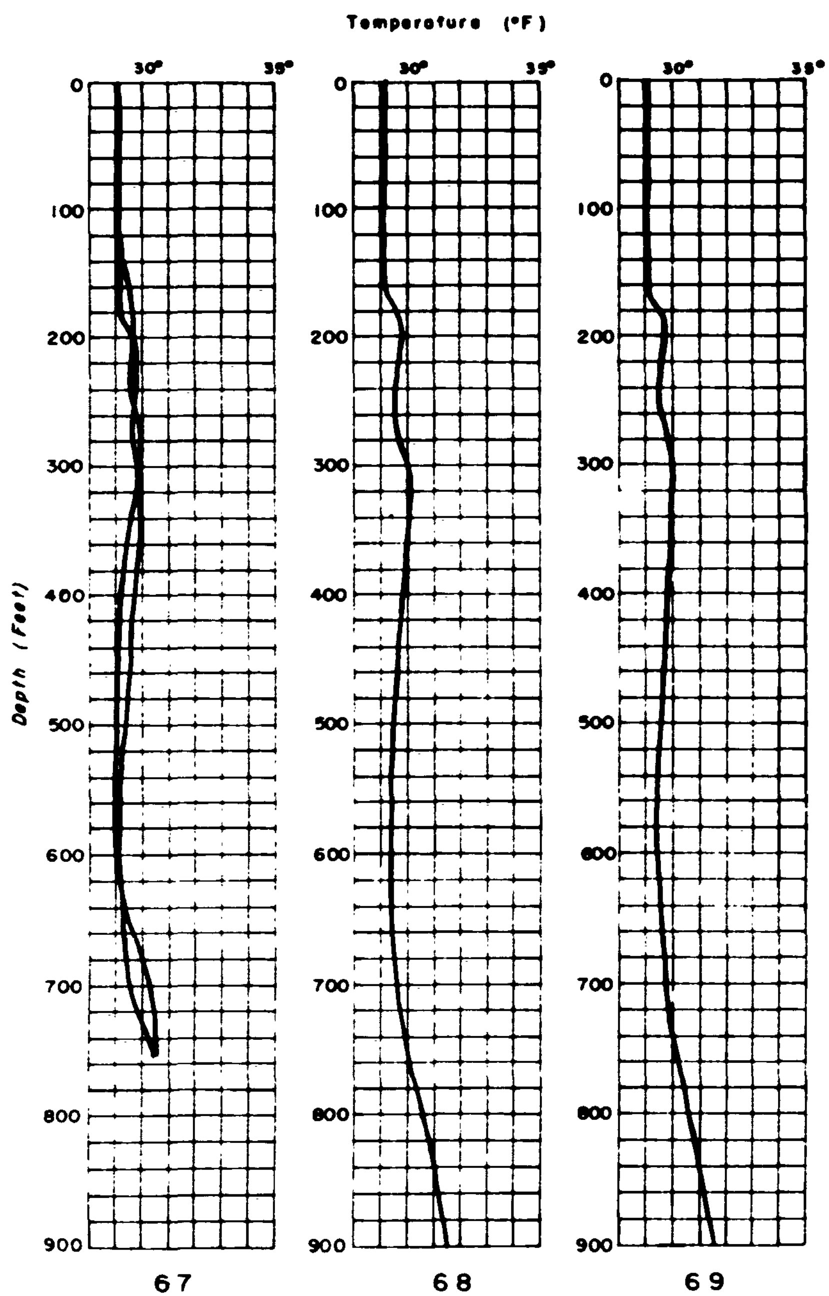
55 56 57

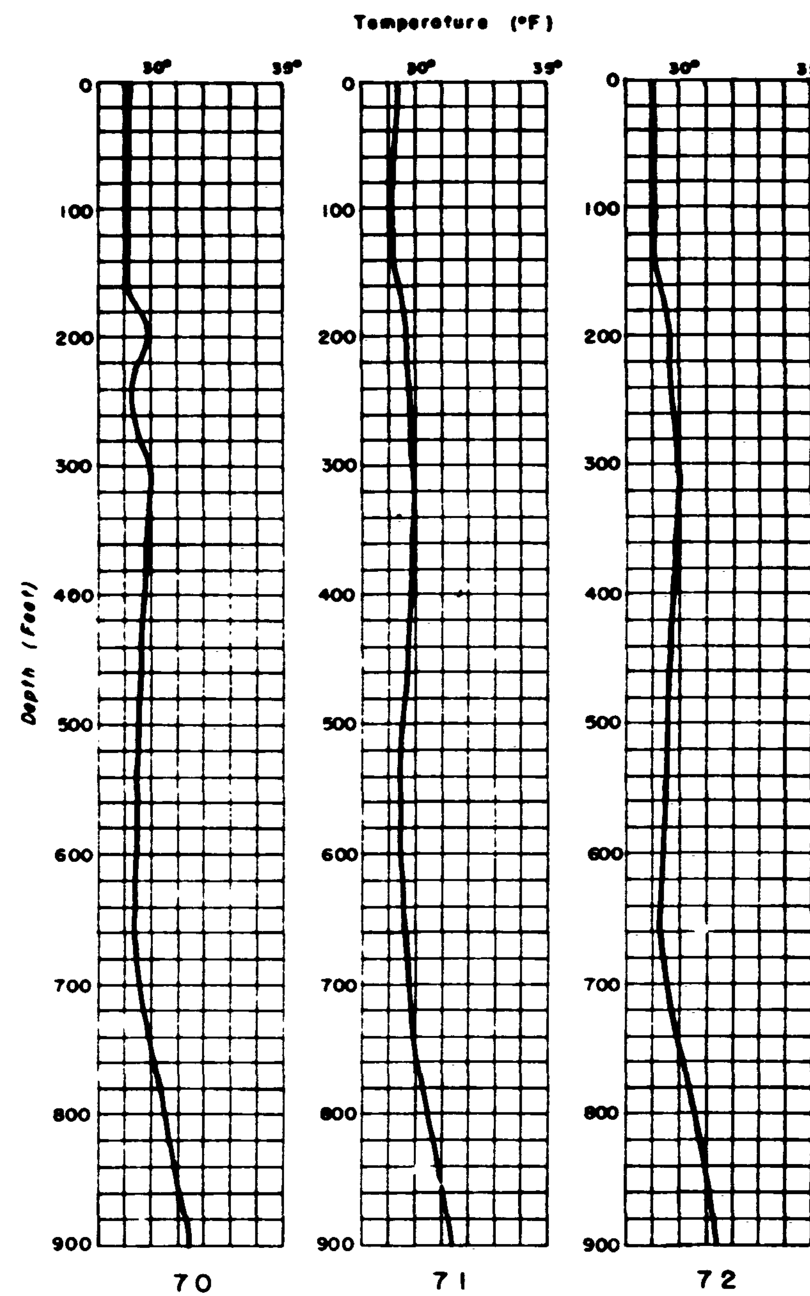


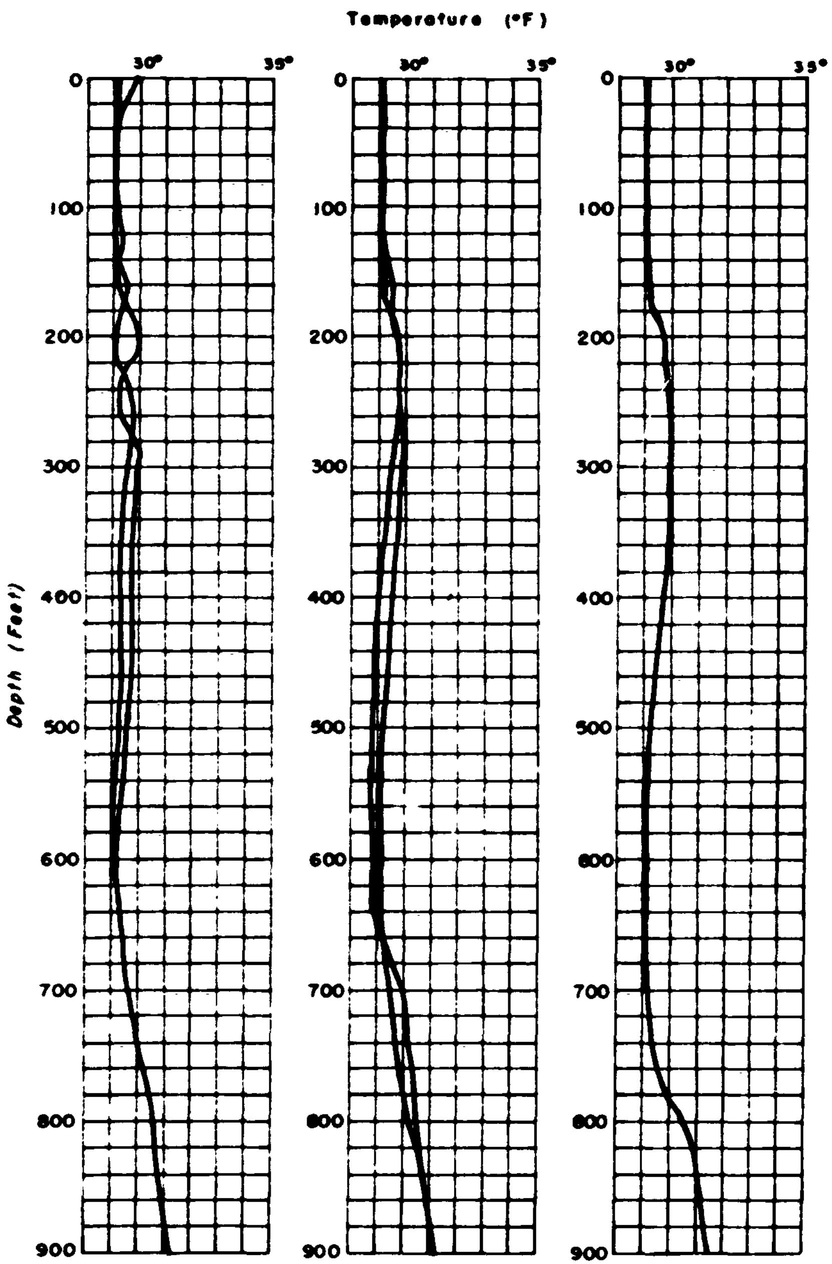
58 59 60

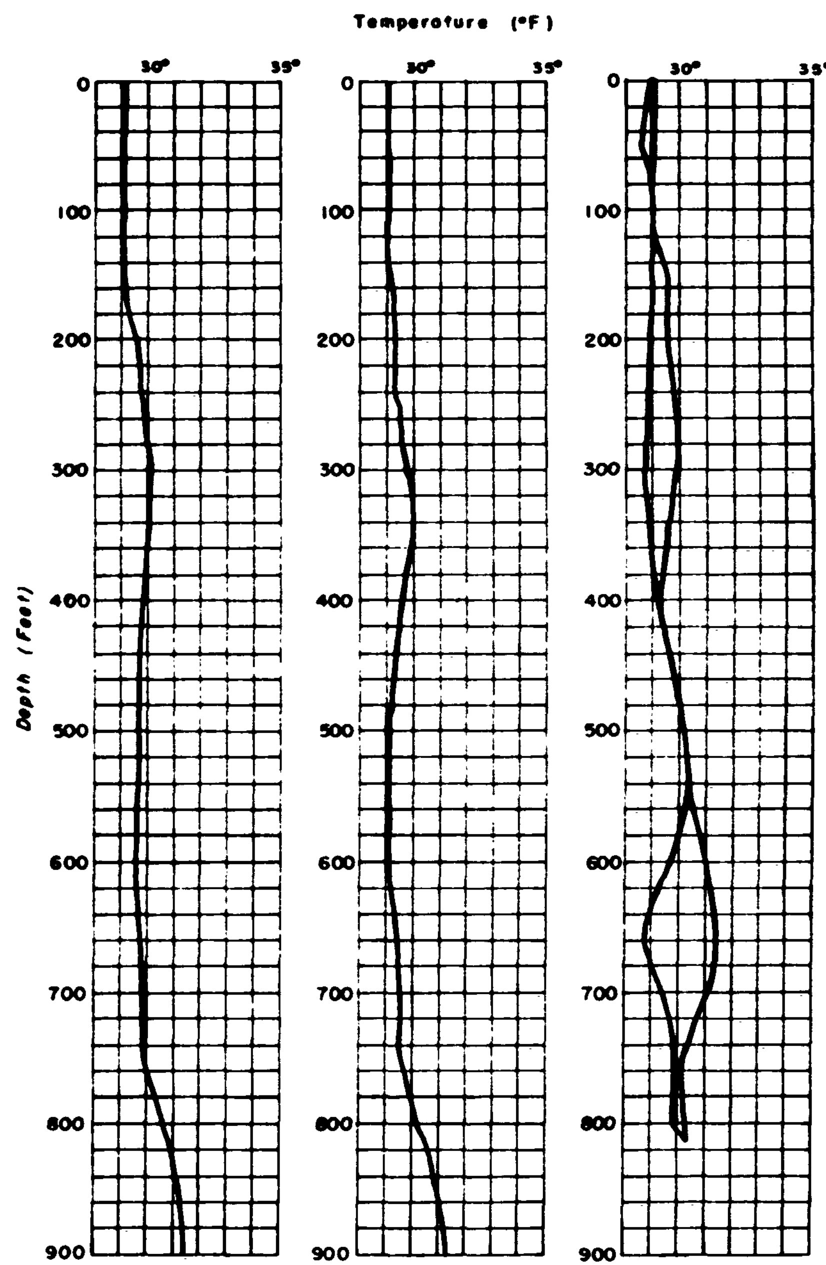

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
61
62
63

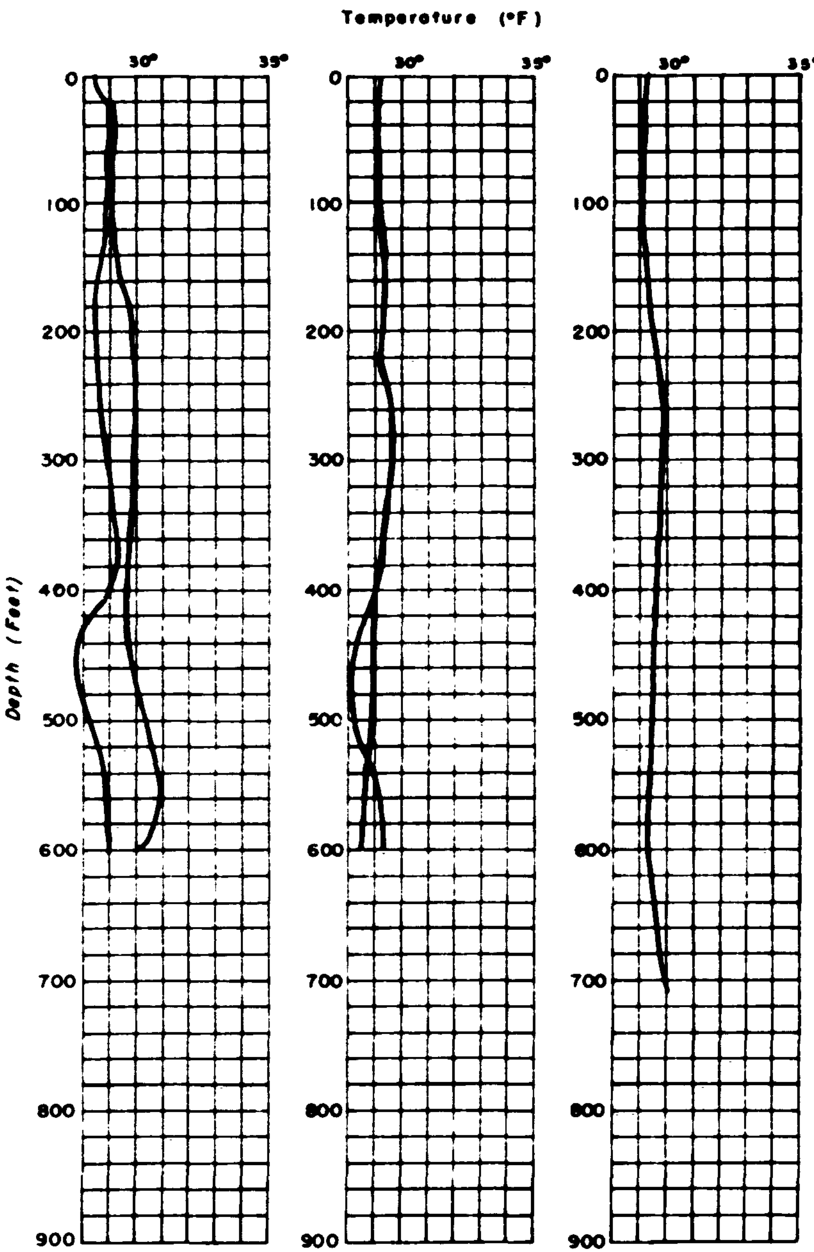

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
64
65
66


Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
67
68
69

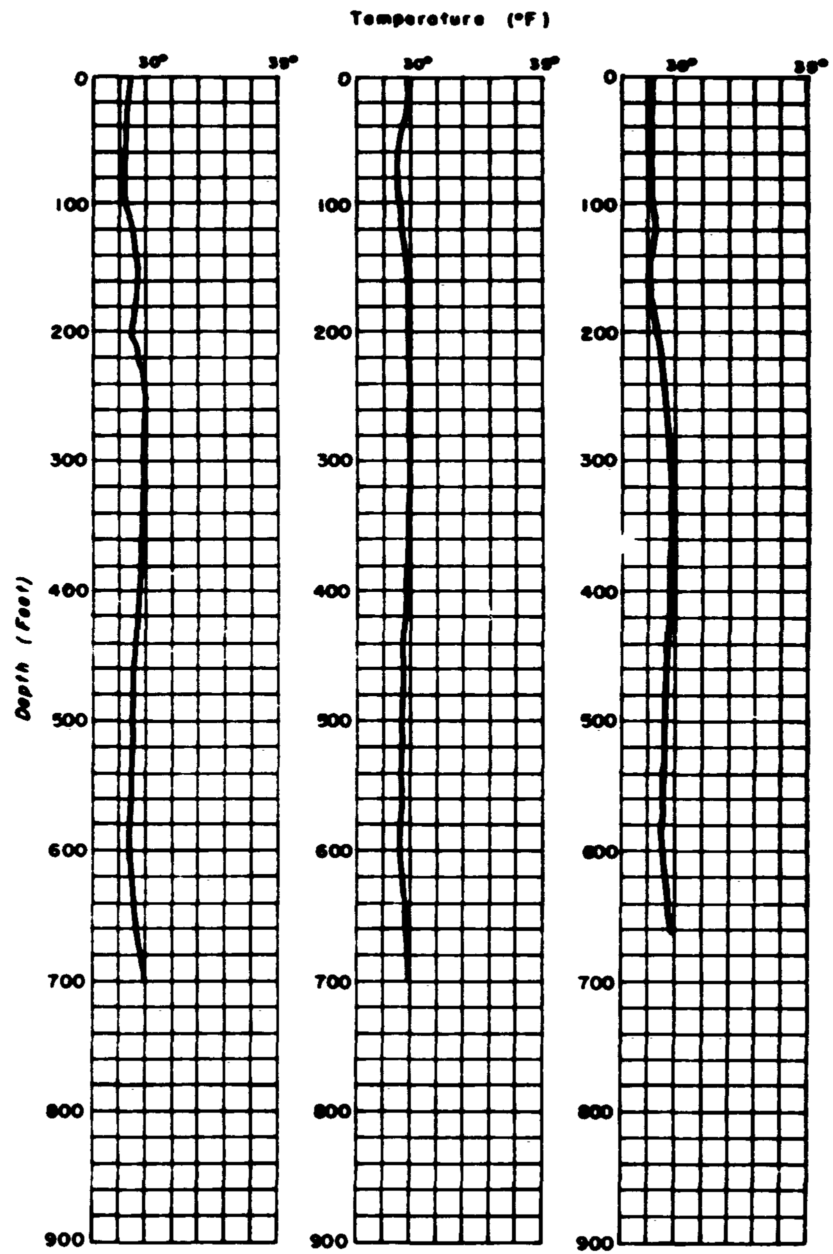

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
70
71
72


Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
73
74
75

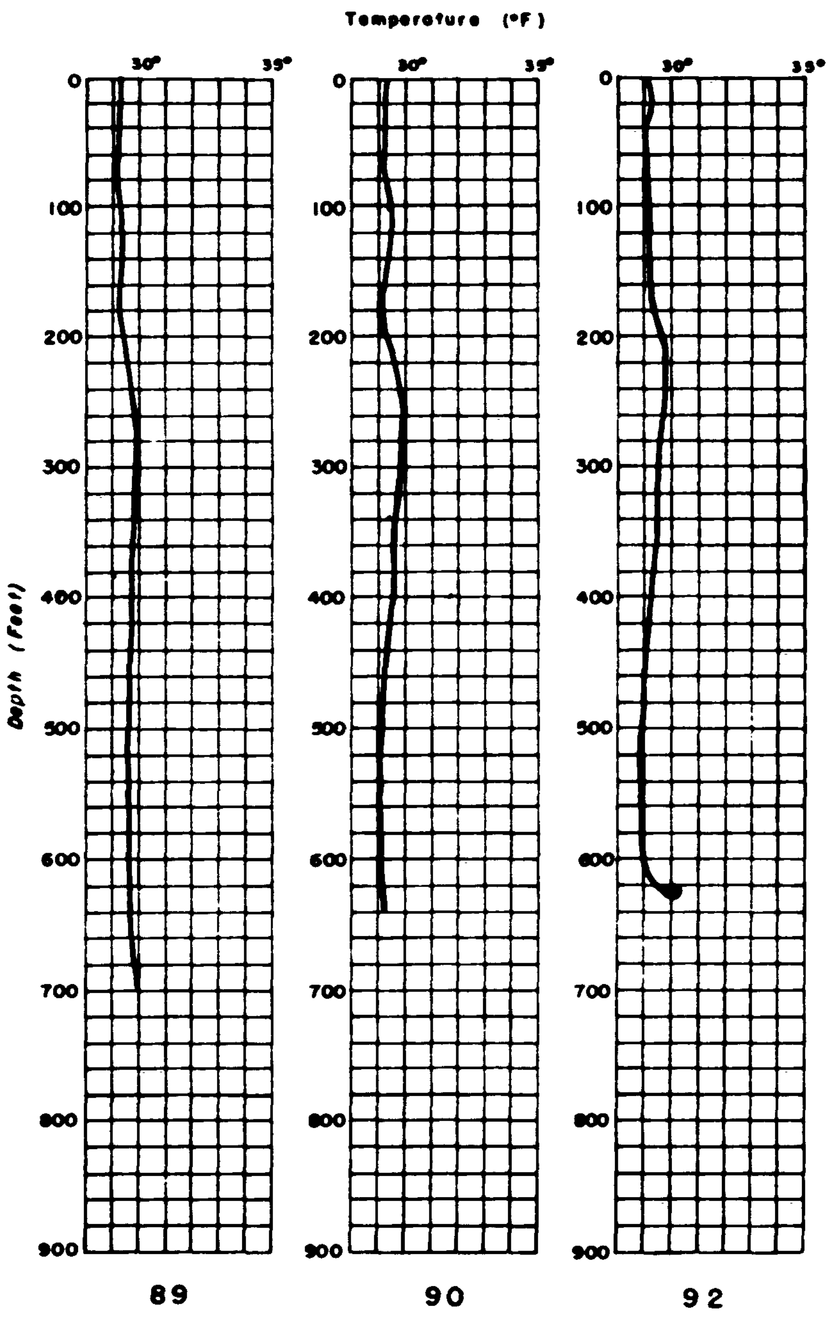

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
76
77
78

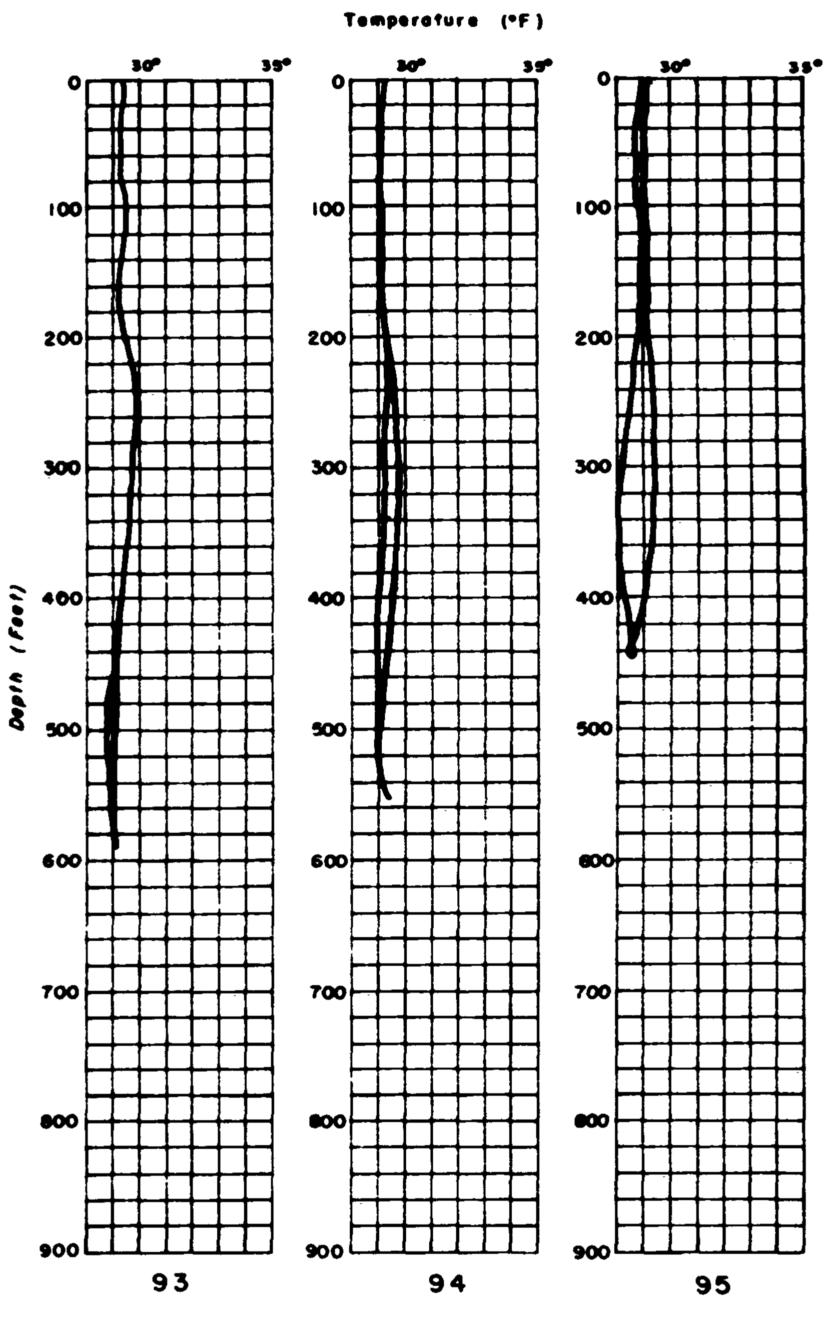


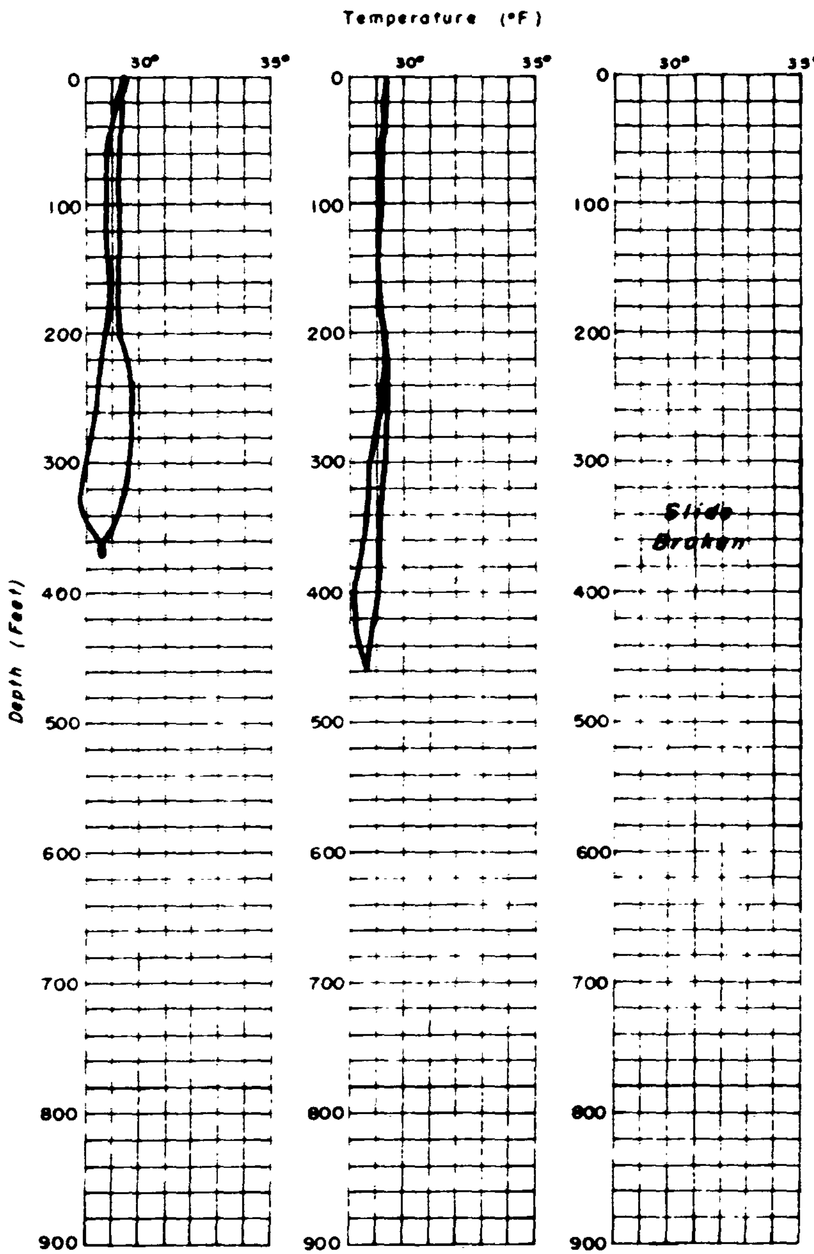
79 81 85



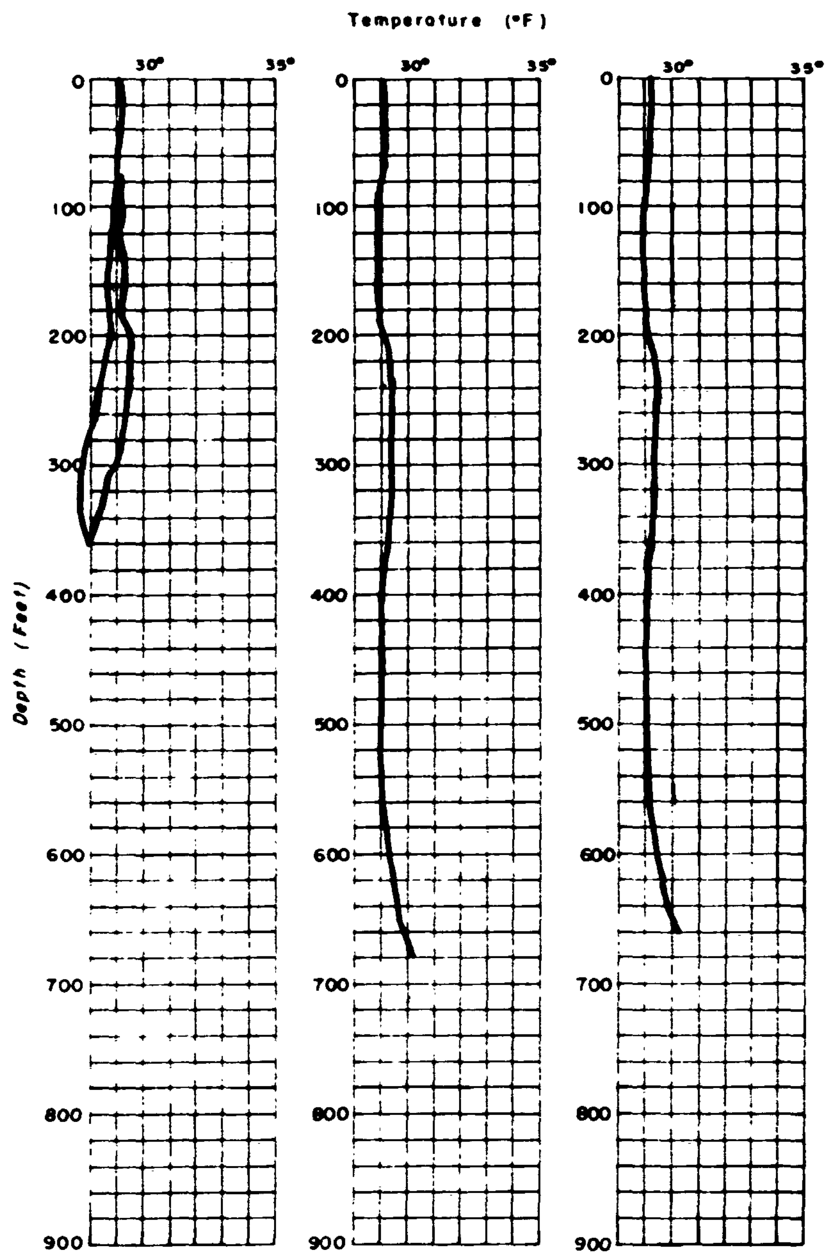
86 87 88


Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
89
90
92

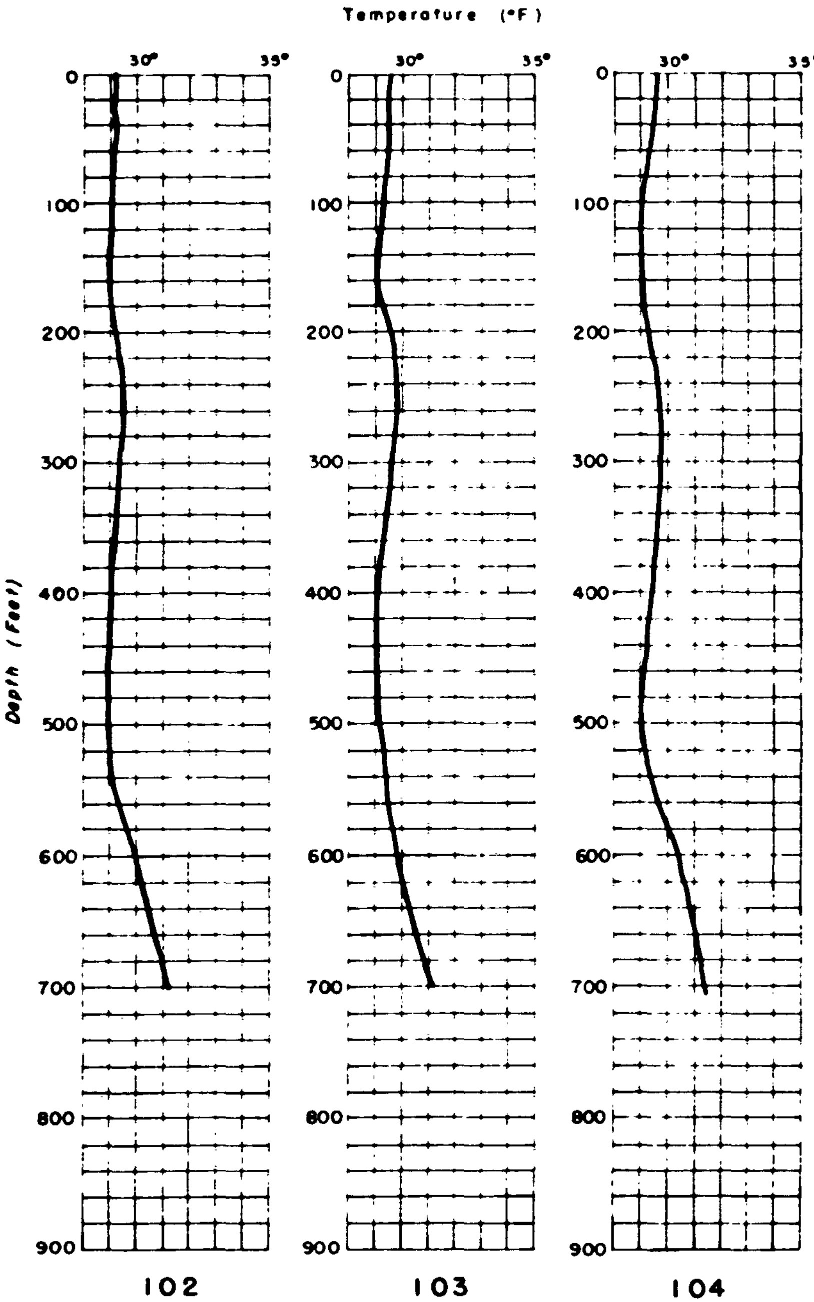

Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
93
94
95



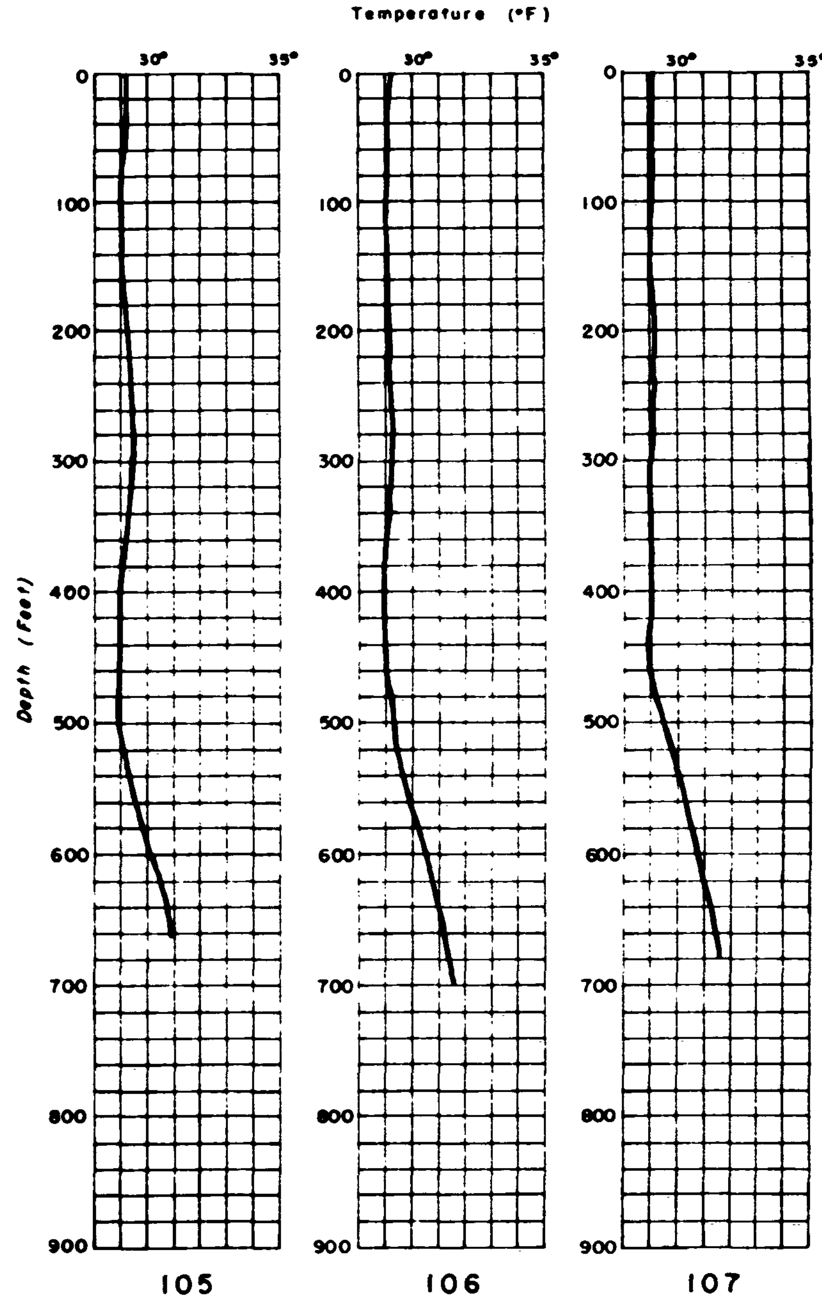
96 97 98



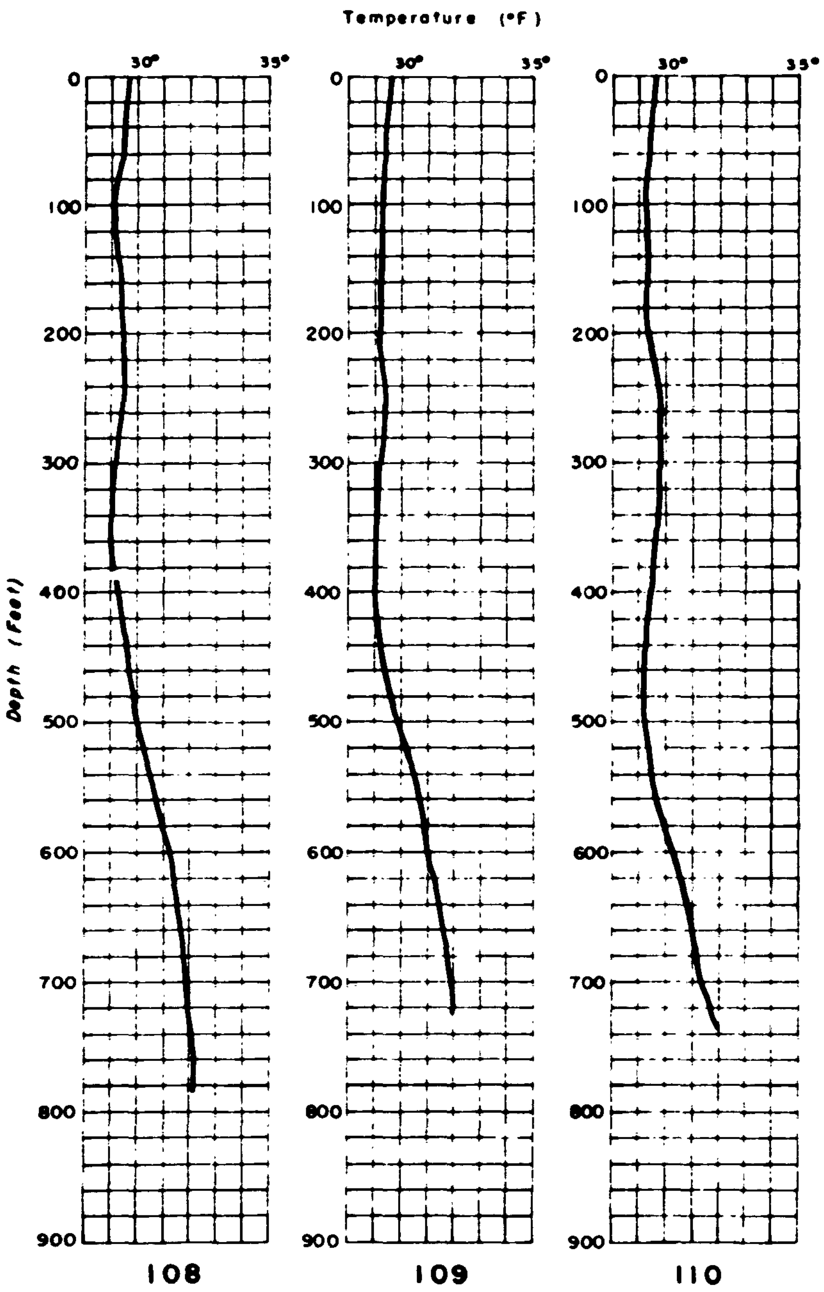
99 100 101



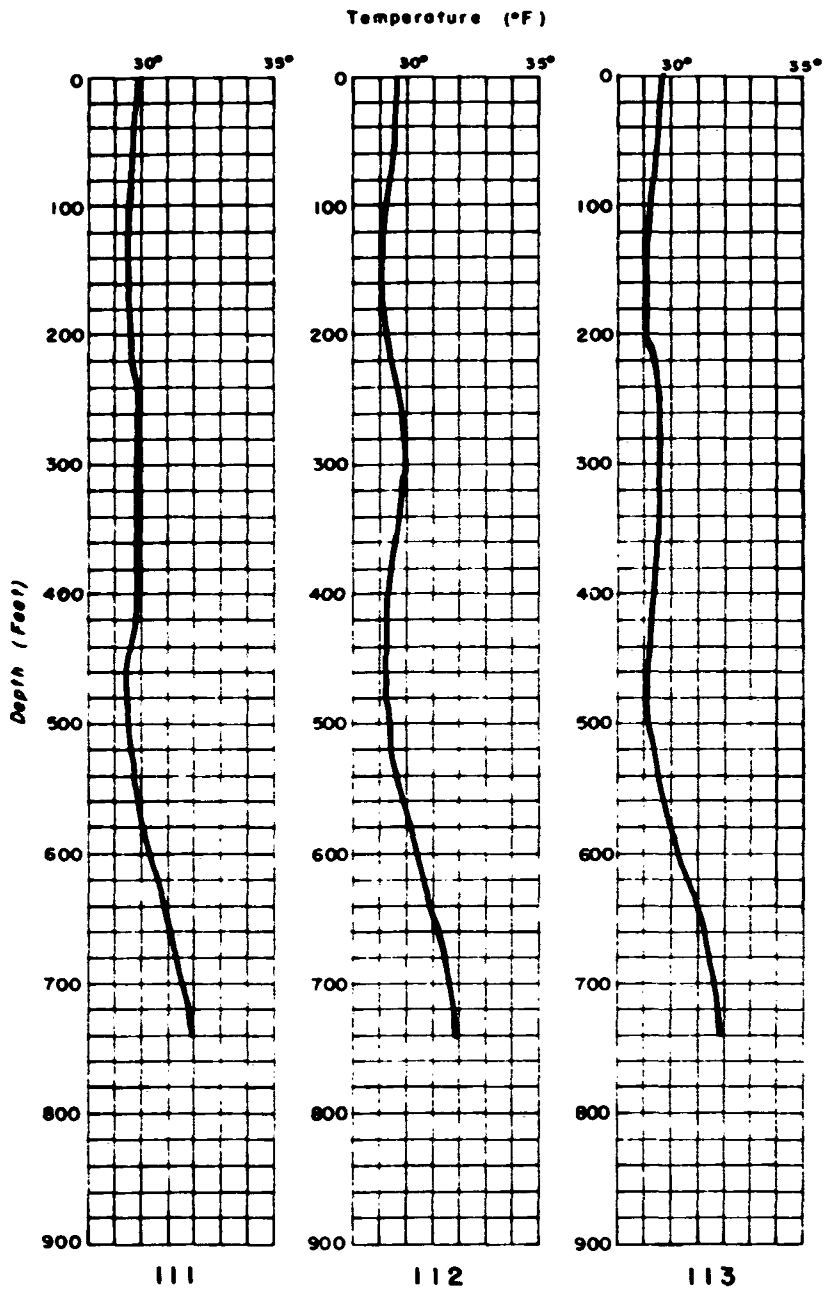
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
102
103
104



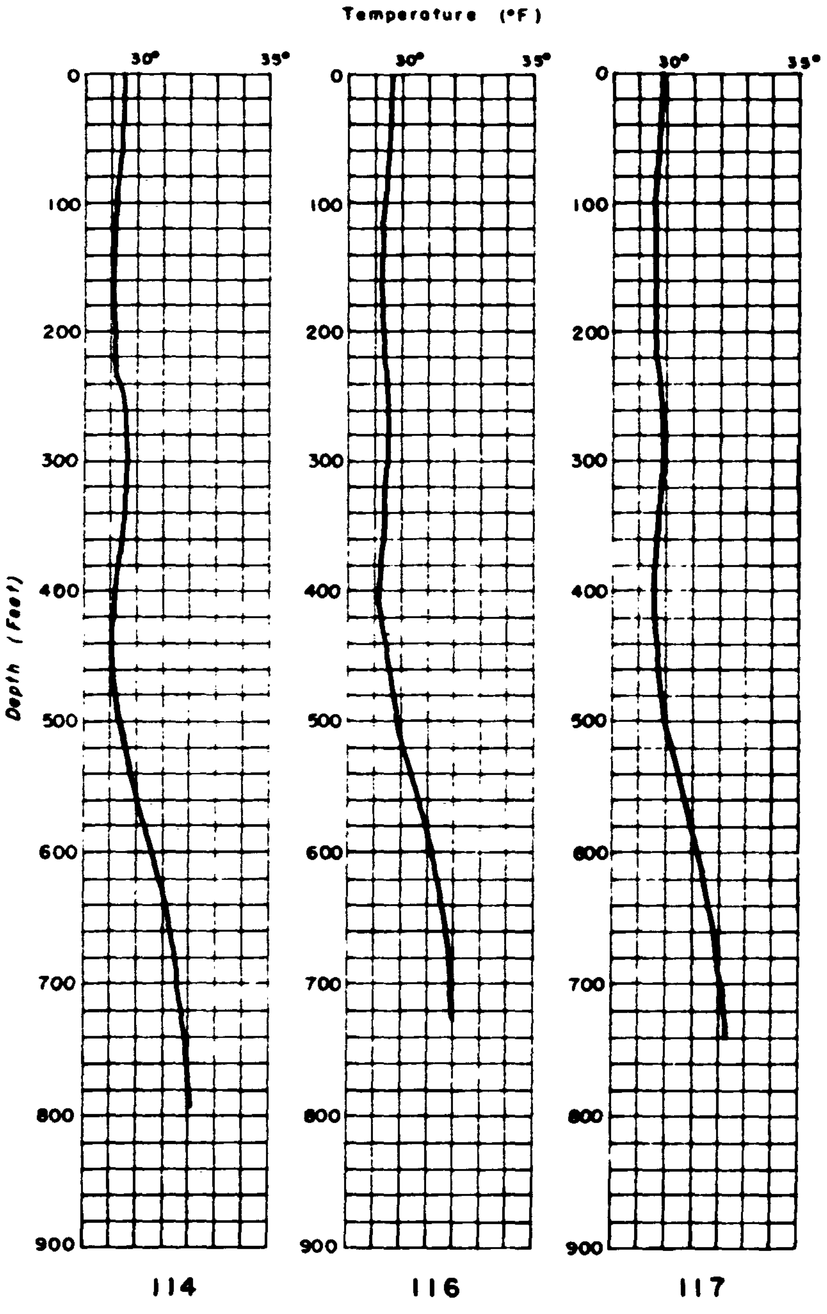
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
105
106
107

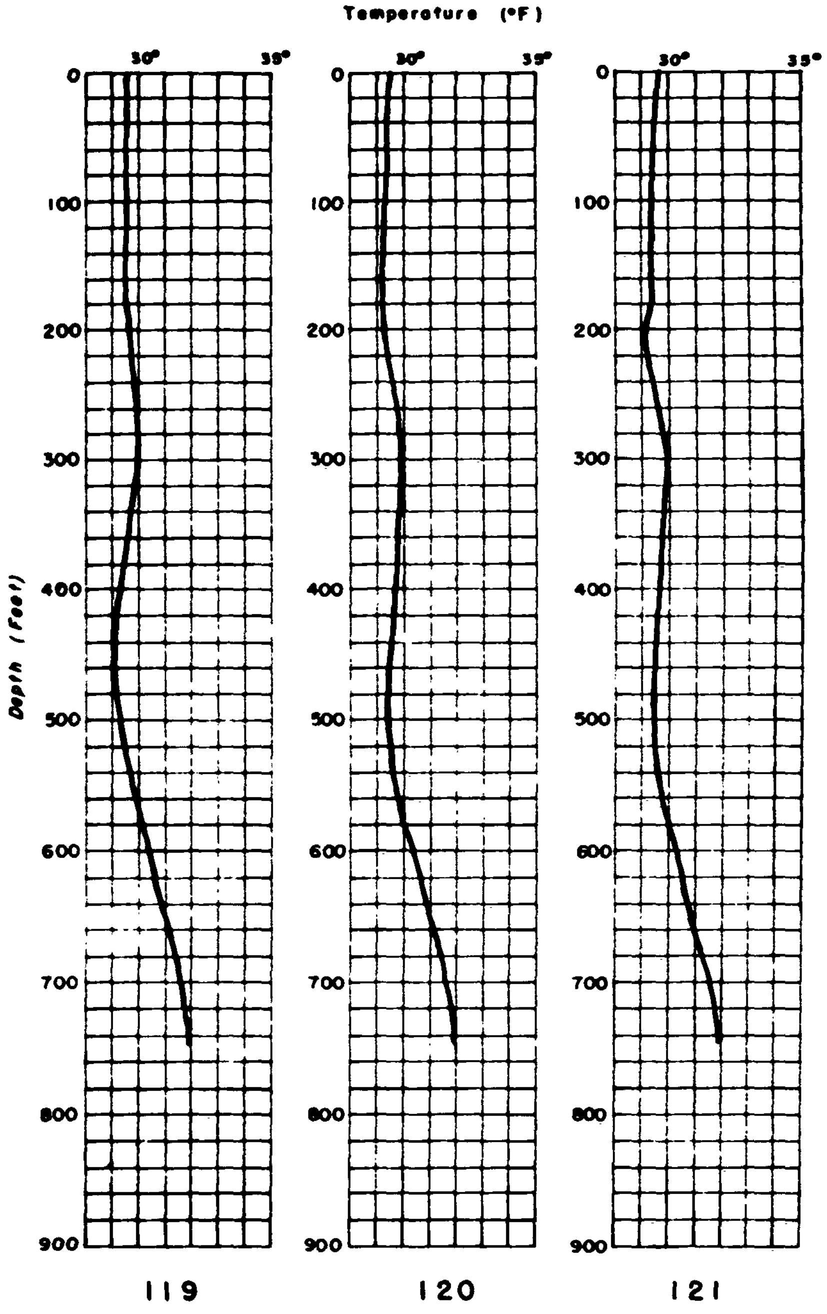


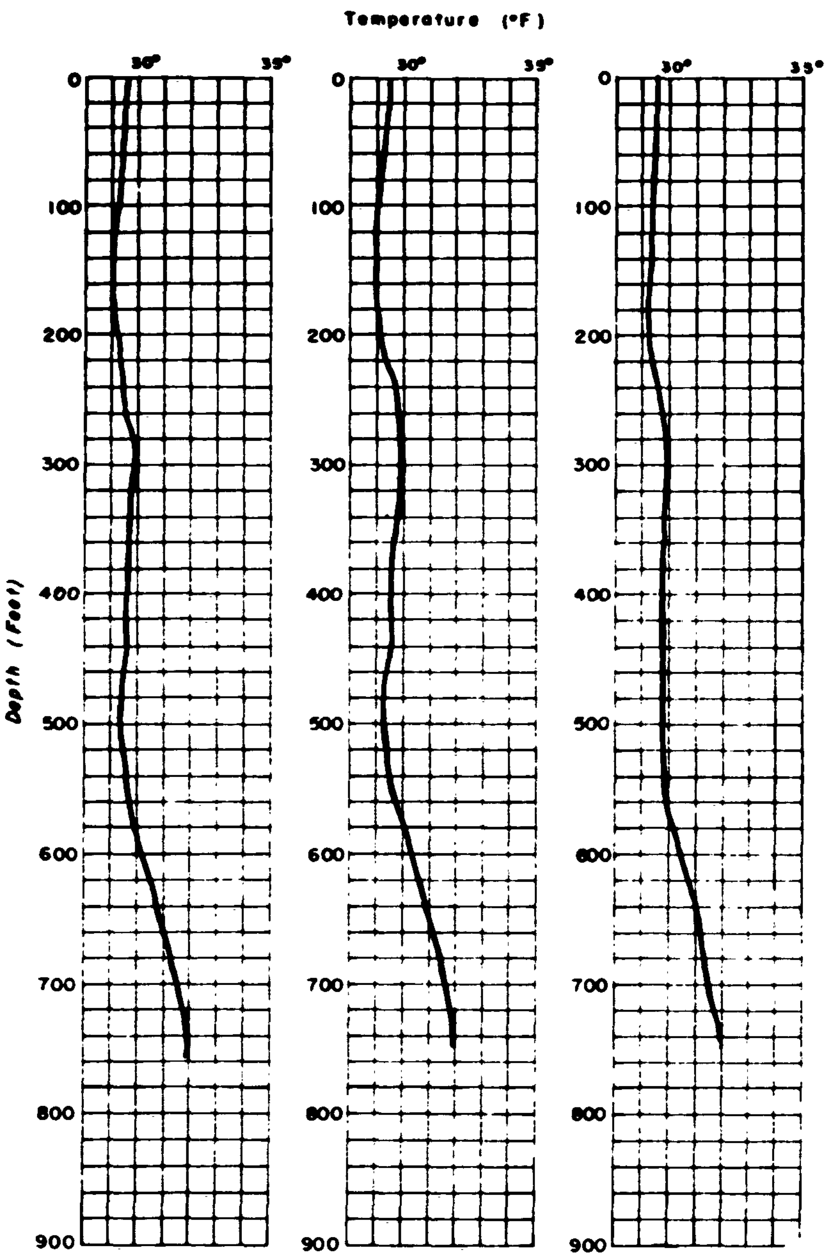
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
108
109
110



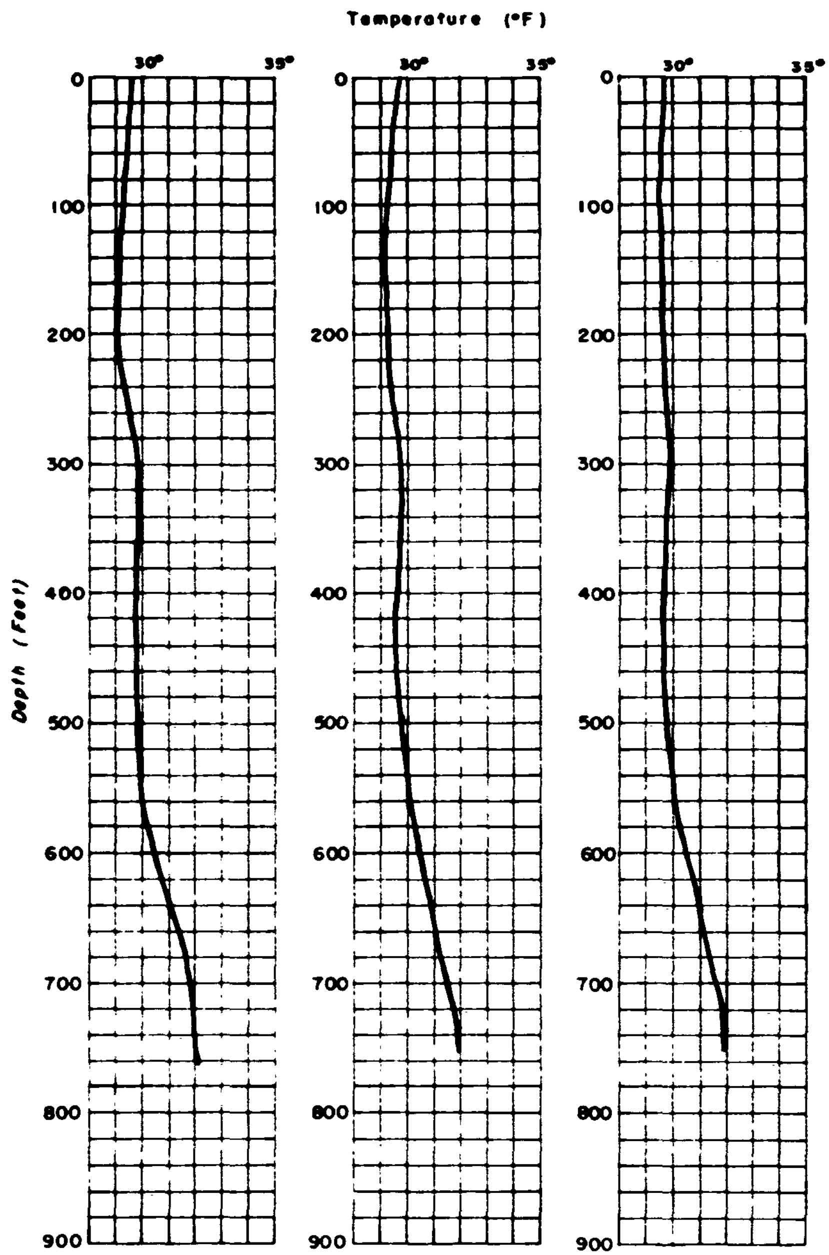
Temperature (°F)
30°
35°
Depth (Feet)
0
100
200
300
400
500
600
700
800
900
111
112
113


Temperature (°F)
Depth (Feet)
30°
35°
0
100
200
300
400
500
600
700
800
900
114
116
117

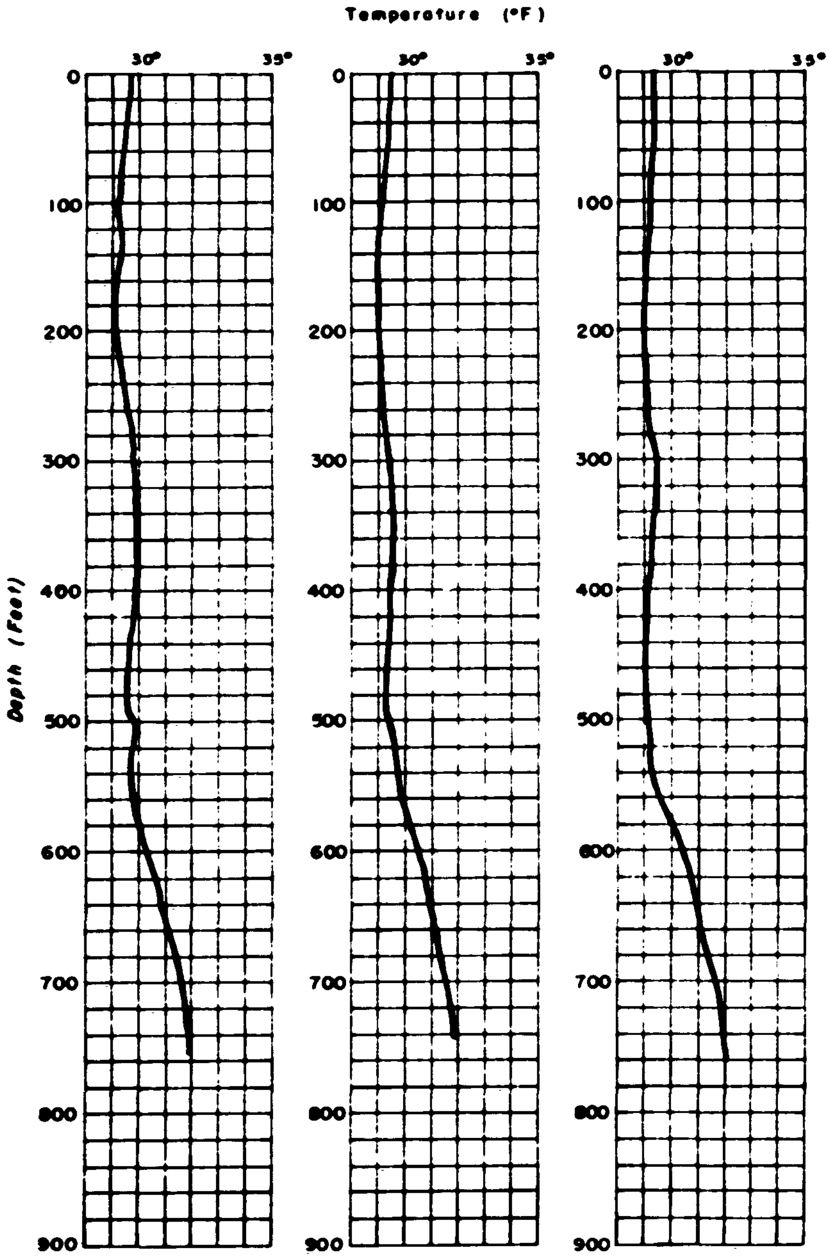

Temperature (°F)
Depth (Feet)
30°
35°
0
100
200
300
400
500
600
700
800
900
119
120
121



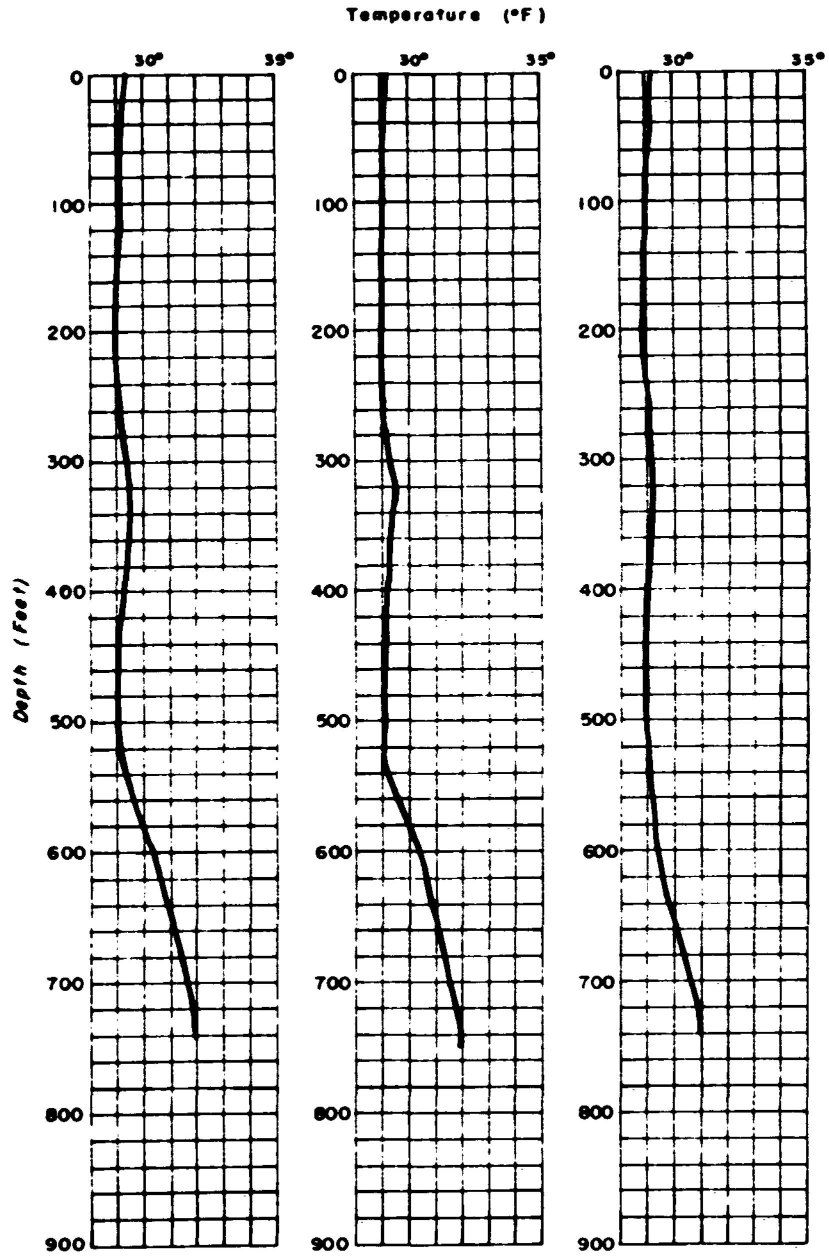
122 123 124



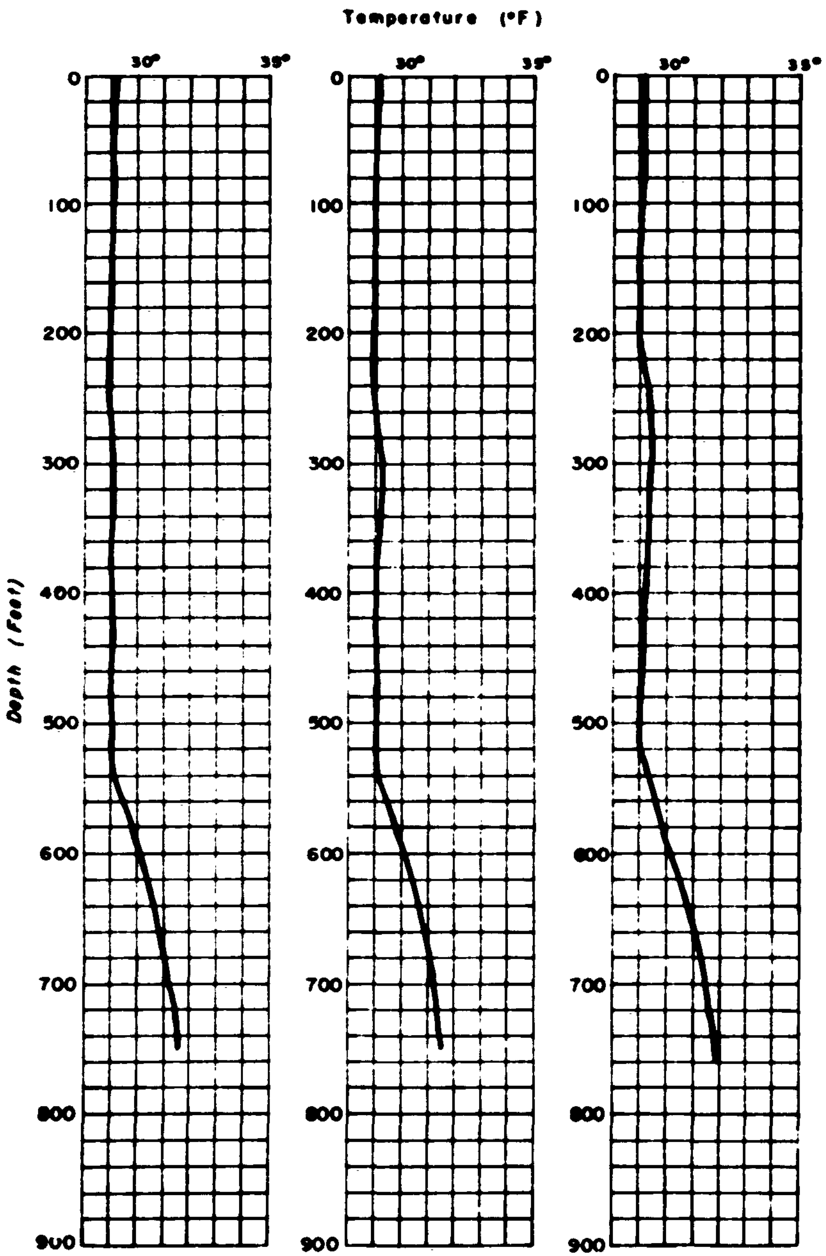
125 126 127



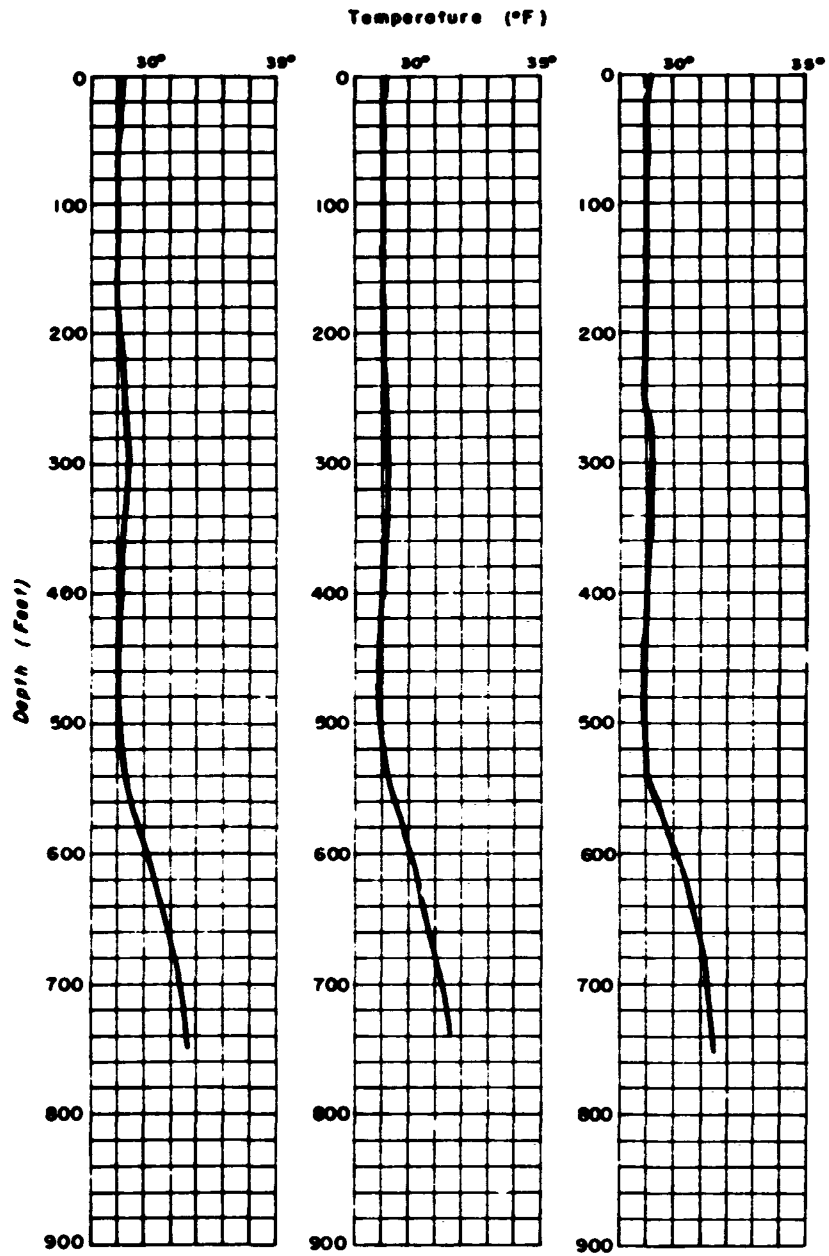
128 129 130



131 132 133



134 135 136



137 138 139